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CATALOGUE
OF THE
MADREPORARIAN CORALS

IN THE
BRITISH MUSEUM
(NATURAL HISTORY).

VOLUME I.
THE GENUS MADREPORA.

BY
GEORGE BROOK.



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P R E F A C E.

THE first attempt to get the Collection of Stony Corals in the British Museum into systematic order was made in the year 1876, when the Trustees engaged Dr. Brüggemann to prepare a complete Catalogue. Unfortunately, the work of this able Zoologist was interrupted by his premature death in 1878, and for various reasons could not be resumed for many years. In the interval important additions were made to the collection, of which the specimens collected by the Naturalists of the 'Transit of Venus,' 'Alert,' and 'Challenger' expeditions should be specially mentioned; then, in more recent years, when the question about the formation of Coral-reefs had been reopened, a considerable amount of material was received from several Naturalists who took special interest in this inquiry: especially from Dr. Guppy, who collected in the Solomon Islands; from Mr. G. C. Bourne, who investigated the coral-reefs of Diego Garcia; from Mr. J. J. Lister, who passed some years in Polynesia; from Mr. Bassett-Smith, who, by the instructions of the Hydrographer of the Admiralty, thoroughly searched the Tizard and Macclesfield Banks during their survey by H.M.S.S. 'Rambler' and 'Penguin'; and from Mr. Thurston, who paid several visits to the Ramesvaram reefs. The present work was near its completion when, finally, Mr. Saville-Kent transferred to the Museum the large collection which he had formed on the Great-Barrier Reef and in Torres Straits.

From these and other sources the collection in the Museum has grown to its present extent, the number of specimens of the genus *Madrepora* amounting to 1104. They are described in the present volume under 180 specific names, the total number of species of the genus amounting to 221.

The task of arranging these materials with the nomenclature most conformable to the preceding literature was surrounded by unusual difficulties ; and although the Author was assisted by a series of named specimens of Klunzinger's Red Sea Madreporae purchased some years ago, by one species collected by Haeckel in Ceylon and described by Ortmann, and by the whole of the 'Challenger' types, he would not have succeeded so well in his work if he had not, at considerable personal sacrifice, visited the principal collections on the Continent with the object of studying the types contained in them. The Museum, besides, is greatly indebted to him for the care bestowed on the curatorial part of the work, by which every specimen has been now rendered available for future study.

ALBERT GÜNTHER,

Keeper of the Department of Zoology.

*British Museum, N. H.,
June 16th, 1893.*

INTRODUCTION.

THE total number of species referred to the genus *Madrepora* s. s. up to 1890, when the present work was undertaken, appears to be 157, not including the *nomina nuda* of Valenciennes and other authors. To these must be added twelve or fourteen others recently published by Rehberg. In most cases the species recorded by the various authors have been identified from published descriptions, and I am not aware that any author has compared together the type specimens contained in continental museums. The American types have not been redescribed or refigured since the original publication. The synonymy, therefore, lapsed into a state of confusion, and the lists of species recorded as occurring in certain areas are quite unreliable. It has thus been necessary to make, as far as possible, a renewed study of the type specimens of the numerous species already described. It has not yet been possible for me to study the type specimens preserved at Washington and other places in the United States, and thus I have only been able to judge of the characters and positions of the species described by Dana, Horn, and Verrill from the more or less complete data supplied by these authors. The types described by European authors are in the Museums of Paris, Berlin, London, Strassburg, and Jena, whilst Klunzinger's types are, I believe, preserved in the Museum at Stuttgart, but a complete set is also to be found in the Berlin Collection. I have not yet had an opportunity of visiting the Stuttgart Museum, and my notes on Klunzinger's Red Sea Collection are based on the study of the specimens identified by Klunzinger which are contained in the Berlin and London Collections.

I am glad to have this opportunity of expressing my hearty thanks to the various gentlemen who have given me facilities for my study and assistance during its progress. I may be permitted to mention the names of Professor Perrier and M. Bernard in Paris, Professors Möbius, von Martens, and Dr. Weltner in Berlin, Professors Haeckel and Kükenthal in Jena, and Professor Döderlein and Dr. Ortmann in Strassburg, all of whom gave me every assistance in their power. To Dr. Weltner I am further indebted for much valuable information on the Berlin types which he has been kind enough to supply since I visited the collections.

It was at the suggestion of Dr. Günther that the present work was undertaken, and his constant interest in its progress and the readiness with which he has given me assistance and advice in critical points have been a source of great encouragement to me. I have also pleasure in acknowledging the assistance rendered by my friend Prof. Jeffrey Bell.

As a result of the comparison of the various European Collections already referred to, I have considered it necessary to reduce the number of distinct species described by previous authors from 169 to 130. To this number must be added the new species described by myself—91 in all. Short descriptions of 62 of these have already appeared in the 'Annals and Magazine of Natural History' for December 1891 and 1892. The remainder are now described for the first time. Some are based on specimens in the Collection of the British Museum, whilst others are founded on specimens referred to previously described species by various authors.

For some time the idea was entertained to include an account of the fossil species of *Madrepora* in the present volume. Very little is known as to the position and affinities of the fossil species, and a careful study of their relations to existing forms would be of special interest on account of the great importance of the various species as reef-builders. The subject is, however, a very difficult one; the type specimens are scattered, imperfectly described, and rarely figured, added to which most of the specimens which have come under my notice are fragmentary. Satisfactory material is not readily obtained, but even if that

had been available, the advantages to be derived from a study of it would have been doubtful, inasmuch as in the greater number of the fossil forms the characters on which the classification of recent species is based are not preserved with sufficient clearness to admit of comparison.

The Plates which illustrate the present volume have been reproduced by the Collotype process by Messrs. Morgan and Kidd from negatives taken by myself. For various reasons it was often found impracticable to represent closely allied species on the same Plate. As isochromatic plates were chiefly used, the difference in the depth of colour of the various specimens accounts for the variation in intensity of the figures on some of the Plates. The scale on which the specimens are figured is also not constant, and depends entirely on the reduction necessary for each specimen or group of specimens in order to fill a 10- by 8-inch plate. I trust that sufficient detail will be found in the figures to give a good idea of the habit of the specimens, and also, although necessarily to a less extent, of the form, angle, and variation of the corallites.

GEORGE BROOK.



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CATALOGUE

OF

MADREPORARIA.

GENERAL REMARKS.

HISTORICAL.

THE name *Madrepora* appears to have been first used by Imperato in 1599, but its precise significance, or rather the sense in which the term was originally employed, does not appear to be generally understood. The derivation usually given (*cf.* 'The Century' and other dictionaries) is *madre*, Ital., and the Greek *πῶρος*, or possibly *πόρος*. The affinity to Ital. *madreperla*, mother-of-pearl, is evident. Imperato* describes and figures a number of Zoophytes, which he classes together as *Pori*. This group is divided into *Millepora*, *Madrepora*, *Retepora*, *Fron dipora*, *Tubulara*, &c. His work was published at a time when naturalists were anxious to show that the animal and vegetable kingdoms meet in a common area, the sea, and there produce an intermediate type of structure. Imperato is therefore especially concerned to prove the "animal" nature of his *Madrepora*, and in doing so makes use of several expressions which are quoted by Donati and appear to indicate the association of ideas which led to the use of the word. The following quotations from Donati's work† (French edition, 1758) are a free translation of the original of Imperato:—In "*Madrepora*" "les nouvelles additions se forment en consistance de Pore, et de substance charnue *Madrepora*, amas épais de Pores on croit que c'est une mère où se forment des animaux marins comme les abeilles dans les gâteaux de cire. . . . La tubulaire [the calcareous cups] n'est qu'un réservoir d'animaux." The figures of "*Madrepora*," in Imperato's work appear to represent a species of *Dendrophyllia*, probably *D. ramea*. In the

* 'Dell' *Historia naturale*' (Napoli, 1599); Latin transl., Coloniae, 1695.

† 'Essai sur l'histoire naturelle de la Mer Adriatique' (La Haye, 1758).

text the word is spelled *Madripora* (p. 717), but in the explanation of the figures the *i* is replaced by *e*. In the Latin translation of Imperato's work, published in 1695, the word "Madrepore" is always translated "Porus matronalis." It is clear from the above quotations that Imperato regarded what we now speak of as the "corallum" as a stony "nurse" in the porous cups of which animal polyps undergo their development, and "stony mother" appears to indicate the meaning intended. When Linnæus established his binomial system he borrowed this, among other words, from Imperato and gave it a generic value without adopting a proper Latin construction. There is no doubt that the word is, in the first instance, Italian and Linnæus applied it to the same group of Zoophytes as Imperato had done. As, however, the term was originally used to indicate the "maternal" character of the "stone" rather than its porosity, it appears that the root should be referred to the Greek *πῶρος*, *i. e.* stone, and the English pronunciation of the word altered accordingly. When we come to the consideration of the Linnean genus *Madrepore*, further difficulties arise which are not so easily disposed of. Linnæus established three genera among what are popularly known as Stony Corals. The first, *Tubipora* (= *Tubulara*, Imper.) includes the "organ-pipe" coral and is now referred to the Alcyonaria. The second, *Millepora*, in its present restricted sense, although by no means entirely in the original one, belongs to the Hydrocorallinæ. There remains the third genus, *Madrepore*, which, for practical purposes, may be taken to include the whole of the Madreporaria or Zoantharia Sclerodermata. Subsequent investigators have from time to time subdivided the Linnean genus *Madrepore*, until, up to the present time, over 400 new genera have been proposed. The question then arises, for what part of the original genus has the name *Madrepore* been retained? So far as I can ascertain, the only just reply must be that, strictly speaking, none of the species now referred to *Madrepore* were included in the original Linnean genus. In the twelfth edition of the 'Systema Naturæ' the 33rd species of *Madrepore* described is *M. muricata*, and this, so far as I can ascertain, is the only species which comes within the genus as now understood. The specific name has disappeared from our nomenclature and has been replaced by *M. palmata*, *M. flabellum*, *M. cervicornis*, and *M. prolifera*, all of Lamarck, and possibly also by others. It should be stated that Esper considered species 39, viz. *M. infundibuliformis*, as a variety of *M. muricata*. Linnæus, however, quotes Pallas's *M. crater* as a synonym, and was probably correct in doing so; in that case the species belongs to *Turbinaria* and not to *Madrepore* s. s. If, now, we turn our attention to the 10th edition of the 'Systema Naturæ,' we find that the species named *Madr. muricata* in Ed. xii. is here referred to *Millepora*, whilst *Madrepore infundibuliformis* Ed. xii. appears as *Tubipora* in Ed. x. Thus, if we take the 10th edition as our guide, the name *Madrepore* is now applied to a genus of corals which were referred by Linnæus to *Millepora*, and only on the publication of the 12th edition were the limits of the genus extended so as to receive them. How far Linnæus may have been influenced by the views of Pallas is not certain. In the 'Elenchus Zoophytorum' Pallas quotes "Systema Naturæ, Ed. x.," in the synonymy, and divides the genus *Madrepore* into 7 sections, viz. simplices, concatenatæ, conglomeratæ, aggregatæ, dichotomæ, vegetantes, and anomalæ. In the last section, anomalæ, he arranges three species, *M. muricata*, *M. porites*, and *M. foliosa*. It is interesting

to note that, according to the accepted classification, these three species belong to three allied genera, viz. *Madrepora* s. s., *Porites*, and *Montipora*. On the publication of the 12th Ed. of Linnæus's work the three species in question were placed in the genus *Madrepora*. When Lamarck in 1808 subdivided the genus *Madrepora* and instituted a number of new ones, he unfortunately retained the name *Madrepora* for the group of species represented by *M. muricata*. The definition of the genus given by Lamarck is not characteristic and is equally applicable to the genus *Anacropora*. The genus, as restricted by him, had much narrower limits than those at present recognized and did not include the divisions, or subgenera, *Isopora*, *Trachylopora*, &c., species of which were known to him, but were referred to *Astræa*, *Oculina*, *Porites*, &c. Ehrenberg, in 1834, was the first to give the genus its present limits, but instead of following Lamarck in nomenclature, he proposed a new name *Heteropora* for the genus, on account of the distinction between axial and radial corallites which leads to the characteristic mode of colony-formation. All the species which came under his notice, and which really come within the genus, were, with one exception, correctly referred to it by Ehrenberg. It appears, however, that Blainville* had in 1830 applied the name *Heteropora* to a genus of fossil Polyzoa; and as the name is still in use, and has even been raised to the rank of a family, there is no doubt that *Heteropora*, Ehrenberg, cannot stand. The paper in which Ehrenberg proposed the name, although not published until 1834, was communicated to the Berlin Academy on March 3rd, 1831, and probably at that time the last volume of the 'Dictionnaire des Sciences Naturelles' had not come under his notice.

Dana and all subsequent investigators have in effect adopted the name *Madrepora* as synonymous with *Heteropora*, Ehrb., and have extended the limits of *Madrepora*, Lamk., accordingly.

The question as to the justification of the use of the generic name *Madrepora* in its present sense rests, then, with Lamarck, and the conclusion arrived at will depend on whether the 10th or the 12th edition of the 'Systema Naturæ' is taken as the starting-point. I am aware that in the rules for Zoological Nomenclature adopted by the British Association, the 12th edition is taken as the starting-point; but, at any rate, so far as the Zoophytes are concerned, I see no sufficient reason for doing so. Linnæus could not be expected to have any very accurate knowledge of Zoophytes, and it appears to me unjustifiable to adopt an attitude towards his work which would not be tolerated in any other case. The genus *Madrepora* was established in the 10th edition, and the type of the genus which now bears that name was then referred to *Millepora*; evidently, then, Lamarck ought not to have retained the name in its present sense, but to have applied it to some typical section of the original genus. As, however, he has been followed by all subsequent authors, with the exception of Ehrenberg, it is clear that a change made now which would involve the institution of a new name would not serve any good purpose. We must therefore regard *Madrepora* s. s. as a generic name which, like *Holothuria*, depends for its justification on custom rather than on priority †.

* 'Dictionnaire des Sciences Naturelles,' vol. lx. 1830, p. 381.

† Cf. F. J. Bell, "A Test Case for the Law of Priority," Ann. Mag. N. H. 1891, vol. viii. p. 108.

In an enumeration of the works in which species of the genus *Madrepora* s. s. are recorded it is necessary to begin with Linnæus, who recognized only one species, viz. *M. muricata*. Pallas did not describe any new species, but divided *M. muricata* into three varieties, viz.:—*α. ramosa*, *β. corymbosa*, and *γ.* an incrusting variety. Esper, in his 'Pflanzen-thiere,' figures several varieties of *M. muricata* and also another which he named *M. rosacea*, which appears to be distinct, but had been overlooked until Studer revived the name. Lamarck, in 1816 *, described 9 new species of *Madrepora* and dropped altogether the name *M. muricata*, Linn., to which, indeed, he does not refer in the synonymy. No new recent species are added in the second edition of Lamarck's work edited by Milne-Edwards, but a list is appended of 7 fossil species of doubtful affinity described by Goldfuss and Defrance.

Ehrenberg, in his 'Red-Sea Corals,' recognized 21 species, 13 of which are described as new; the remainder are referred, though sometimes erroneously, to species already described by Lamarck. He regarded *Astræa pulvinaria* and *A. microphthalma*, Lamk., as synonyms of *Madr. palmata*, Lamk., and referred *Oculina echidnæa*, Lamk., to the genus *Madrepora* (*Heteropora*, Ehrb.). It should be understood that, although Ehrenberg's work is nominally on the Red-Sea Corals, several species of *Madrepora* are included in it which were not collected in the Red Sea. In the account of the Zoophytes collected during the voyage of the 'Astrolabe,' Quoy and Gaimard enumerate 4 species of *Madrepora* from Tongatabu and Fiji, all of which are referred to species already described by Lamarck. Unfortunately the descriptions and figures given are so imperfect that subsequent authors have found it almost impossible to identify the species; even Milne-Edwards, who had access to the collection, gave up the task as hopeless.

Next in order follows Dana's work on the Zoophytes of the North-American Exploring Expedition, probably the most important work on recent Corals which has yet appeared. The work contains descriptions of 64 species of *Madrepora* which were observed by the author, 53 of which are described as new; the majority of the new species are figured in the Atlas. Duchassaing, in 1850, published a list of Radiata from the Antilles in which three species of *Madrepora* are enumerated. *M. plantaginea*, Lamk., was probably included in error, and was omitted from the author's later works.

In 1860 the 3rd volume of Milne-Edwards and Haime's 'Coralliaires' appeared, in which the species of *Madrepora* described by previous authors are arranged and classified; eighteen new species are also described. No work of so comprehensive a character has since been published, and the 'Coralliaires' is therefore still a necessary handbook; but its usefulness is considerably interfered with by the shortness and insufficiency of the diagnoses and the almost complete absence of illustrations. It is probably owing to these conditions that subsequent investigators have so frequently failed to recognize the species described by Lamarck and Milne-Edwards.

In 1860 also Valenciennes contributed a short paper to the 'Comptes Rendus' on the

* References to the systematic works are given under each species in the synonymy.

corymbose varieties of *Madrepora*, in which he introduced several new names; but as no proper descriptions accompany them, they have been regarded as *nomina nuda* by subsequent authors. Horn, in 1861, described briefly three new species; but only one of them, viz. *M. tubigera*, has been recognized as distinct by his successors. In the account of the Zoophytes of the Antilles published by Duchassaing and Michelotti in 1861, three new species of *Madrepora* are described, all of which are very imperfectly characterized. So far as can be ascertained, the species in question are simply form-variations of already known West-Indian species.

Verrill's contributions to the subject consist chiefly of three papers. The first is a list of species sent from the Museum of Comparative Zoology to other institutions in exchange. This list includes 36 species of *Madrepora*, three of which are new. In his later work on the Polyps and Corals of the North-Pacific Exploring Expedition, 12 species are recorded, 7 of which are described as new and two or three others are referred doubtfully to species previously described by Dana. None of the new species of *Madrepora* described in either this or the preceding paper are figured, and the exact position of some of them is still uncertain. In the Catalogue of Deep-Sea Corals contained in the Museum of Comparative Zoology, Pourtalès records only three species, all from the West Indies. Haeckel, in his 'Arabische Korallen,' figures three, possibly four, Red-Sea species of *Madrepora* under the name *Heteropora*, Ehrb.

Brüggemann, in 1877, recorded a new species of *Madrepora* collected by Haeckel in the Red Sea and also gave Mauritius as a habitat for *M. gonagra*, Ed. & H.; but the identification in the latter case is probably not correct. In the following year he also included *M. laxa*, Lamk., in a list of corals from Singapore. The species described by Brüggemann under this name does not agree with Lamarck's types, but, probably owing to the fuller description which he supplied, subsequent determinations nearly always refer to Brüggemann's species and not to the true *M. laxa*, Lamk. In 1879 Brüggemann published a report on the Corals of Rodriguez, which includes a list of 11 species of *Madrepora*, one of which is described as new.

Studer's account of the Stony Corals collected in the Pacific Ocean during the voyage of the 'Gazelle' includes 23 species of *Madrepora*, of which 5 are new. The name *M. secale* is also proposed for *M. plantaginea*, Dana, which has generally been held to be distinct from the species described under that name by Lamarck. In a later paper (1880) on the Corals of Singapore, the same author gives a list of 23 species, none of which are new, but figures are given of two or three of the more obscure species. The subgenus *Isopora* was proposed by Studer in this paper.

An important work by Klunzinger on the Red-Sea Corals appeared in 1879, an excellent feature of which consists of the photographic plates. The work has a further value from the fact that the author made a careful study of Ehrenberg's type specimens and gives more accurate descriptions of his species. The work includes descriptions and figures of 24 species of *Madrepora*, of which 17 are recorded as new. This work is excellent, but suffers in some respect from a lack of acquaintance with the types of M.-Edwards, which, it must be admitted, are, in many cases, not sufficiently diagnosed for purposes of identification. In 1880 the

Report on the Florida Reefs by Louis Agassiz was published by his son, the special interest of which, for our present purpose, centres in the three excellent plates of *M. palmata*, *M. cervicornis*, and *M. prolifera*.

In the 'Marine Fauna of Mauritius and Seychelles,' by Möbius, Richters, and v. Martens, seven species of *Madrepora* are recorded by Möbius from Mauritius, which were identified by Haacke; six of the species also occur in the Red Sea. S. O. Ridley, in a paper on the Coral Fauna of Ceylon (1883), records two species of *Madrepora*. H. O. Forbes gives, in his 'Naturalist's Wanderings in the Eastern Archipelago' (1885), a list of Corals collected in the Keeling Islands, which were determined by Ridley and Quelch, in which two species of *Madrepora* are recorded, one of which is named *M. orbipora*, Dana, var.; but no species was described by Dana under that name; the specific name intended is probably *cribripora*.

The 'Challenger' Report on Coral Reefs by Quelch appeared in 1886, and in it fifty species of *Madrepora* are recorded, eleven of which are new. In the same year Duncan described a collection of Corals from the Mergui Archipelago, which included eight species of *Madrepora*, all of which are referred to known species.

In 1888 Rathbun published a catalogue of the species of *Madrepora* in the United-States National Museum. The list includes 59 species in all; the type specimens of 48 of the new species described by Dana and also 6 of Verrill's are in the Collection. The types of the remaining species of *Madrepora* described by Dana appear to have been lost, excepting in the rare instances (e. g. *M. digitifera*) where the species were described from specimens already in the collection of other institutions. This collection also contains the type of *M. secale*, Studer (= *M. plantaginea*, Dana, non Lamk.).

Ortmann has published two important descriptive papers in which numerous species of *Madrepora* are recorded. The first, published in 1888, is a list of the collection of Corals in the Strassburg Museum. In this paper 44 species of *Madrepora* are enumerated, only one of which is described as new, but in the case of 8 others the reference to known species is made with considerable doubt. The second paper is devoted to a description of a collection of Corals made by Haeckel in Ceylon, the types of which are in Jena; 27 species are here recorded, 5 of which are described as new to science. In Faurot's 'Report on the Red Sea Mission,' published in 1888, 4 species of *Madrepora* are recorded, 3 from the Gulf of Aden and 1 from Kamaram Island.

In 1890 Bassett-Smith described a collection of Corals from the China Sea (Macclesfield and Tizard Banks). In this paper 30 species of *Madrepora* are enumerated, 4 of which are described as new, but a fifth, which is considered new, is not named. An interesting feature in this collection is the fact that all the new species were obtained at depths between 23 and 30 fathoms. In the same year Thurston published a paper on the Fisheries and Marine Fauna of the Gulf of Manaar, in which the occurrence of 3 species of *Madrepora* is recorded.

Since the systematic portion of this work was completed, a paper by Dr. Rehberg, "Ueber neue und wenig bekannte Korallen," has come into my hands; it was published in November

last shortly before the appearance of my second contribution on the new species in the British Museum, but I did not see a copy of it until the end of December. Rehberg's work is based on a study of the German Collections, and especially of that in Hamburg; but he has also studied the Berlin Collection, and specimens from the collections in Kiel, Lubeck, and Bremen. A long list of species is given according to their geographical distribution, but, as already pointed out, such lists, unless accompanied by a complete revision of the synonymy, are not reliable. This paper also includes descriptions of 10 new species, and notes on a number of other species. I have not seen the specimens described and recorded by Rehberg, and I therefore do not feel justified in fully criticizing his results, nor in including the species recorded by him in my synonymy, excepting in a provisional way. To some extent a rectification of specific names is necessary between us. Rehberg describes a new species, *M. incrustans*, one specimen of which is in the Berlin Museum; this specimen is referable to *M. plicata*, a species which I described in 1891, and I therefore presume that *M. incrustans* is a synonym. The name *M. edwardsii* is proposed for *M. echinata*, M.-Ed. & H. (non Dana), from Luzon. I do not know if Rehberg has studied the Paris type, but I did not myself note any difference between the specimens referred to Dana's species by Milne-Edwards and the species which I regard as *M. echinata*, Dana, but there is little doubt that the figure given by Milne-Edwards does not represent Dana's species. In the geographical list (p. 33) a species is referred to as "*M. symmetrica*, n. sp.—Palau." No description of this species is given in the text, and I therefore cannot say if it is the same as *M. symmetrica* from Mauritius, which I described in 1891; if not, it must be regarded as a *nomen nudum*. Again, plate iv. fig. 10 is referred to *M. spinosa*, n. sp., but no species is described under that name in the text. Rehberg gives the name *M. coronata* to a new species from Madagascar. I have also used the same name for a different species from the Great-Barricade Reef, 1892 paper; Rehberg's name has priority, and I have therefore changed the name of *M. coronata*, mihi, in the present work.

The views as to synonymy which we derived from a study of the Berlin Collection are by no means identical. I understand that Dr. Rehberg was unable to find many of the specimens which I saw later, and I may also state that as in no case did I find the original labels on the specimens, I had to spend considerable time in referring to the original labels and comparing the specimens with the descriptions so as to make sure that the specimens which I studied were really the types.

MORPHOLOGY.

Skeleton.—Duncan * has given an account of the structure of the corallum in three species of *Madrepora*. The first species described was not determined, but is an arborescent form with long slender proliferous branches, and may be taken as an example of quick-growing species, in which the corallum is not thickened by a secondary deposition of carbonate of

* "On the Hard Structures of some Species of *Madrepora*," Ann. Mag. N. H. 1884, vol. xiv. pp. 181-191.

lime, excepting in the older parts: The corallite-wall is very perforate and costate externally; the costæ often project as trabeculæ. The wall of young corallites consists of only one layer of mural tissue, and is provided externally with plain or finely serrate costæ for some distance down. In older corallites spinules are always present on the free edges of the costæ, and these are largest round the bases of the corallites, where they form a basis of lax tissue which is the first stage in exogenous growth, and occasionally assists in the production of buds. The formation of mural tissue takes place in the following manner:—The spinules act as props on which a porous layer of new tissue is formed in such a manner that the old wall forms the floor of a chamber, and the spinose costæ the supports of the new roof. In old and in axial corallites the costæ assist in the formation of a new layer of tissue by sending out lateral spinules from the free edges. In transverse sections of corallites of moderate thickness the wall is seen to consist of “concentric circles of thin calcareous structure . . . separated by radiating pillars; the circles having been, in turn, outside walls and the radii either spinules or costæ.” If the corallite is old the first, second, or third circles of tissue, next to the septal cavity, are dense. The costæ are imperforate, and as a rule the septa also. Buds from a radial corallite are formed from trabeculæ which arch over and form a low hood. The costæ next appear on the outer surface of the hood, and after elongation the septa appear; these arise first as linear series of spines directed inwards. No communication between the cavities of the bud and axial corallite exists, “except in a very indirect manner and through the medium of the dermal structures. Budding takes place remote from the calicular margin, and may arise from sclerenchyma remote from the wall of the corallite.”

In the second species described, probably a variety of *M. cytherea*, Dana, from Madagascar, there are numerous immersed corallites. These are closely arranged, and their walls are well defined in longitudinal section, and well-developed trabeculæ pass completely across the polyp-cavities. Between neighbouring corallites the connecting structures are in successive layers or storeys of laminæ separated by rows of small, irregular, and short pillars. On the upper surface between the immersed corallites numerous minute, broad-based, sharp-pointed spinules occur, arising from a perforated calcareous lamina; this is precisely the condition of the successive layers below the surface, and new layers are evidently here added in the same manner as on the corallite-wall.

The third species described is referred by Duncan to *M. granulosa*, Ed. & H., but judging from the description, and from small carmine-stained fragments which I believe to be the material investigated, I am inclined to think it more nearly related to *M. secale*, Studer. In any case the species serves to illustrate the structure of slow-growing varieties in which the corallum is compact. The surface is here very dense, and consists of a stout lamina with very few perforations, and is clothed with knobbed spinules in place of costæ. In transverse section concentric laminæ, as in other cases, are separated by radially disposed bars which represent former spinules. In this case, however, the laminæ are much thicker and denser and are closer together. Exceedingly narrow tubes lead from the polyp-cavities to the surface, but their apertures are difficult to detect, as they are surrounded by the bases of spines. Little need at present be added to the results of Duncan. Evidently the condition of the

surface of the corallum may be generally taken as a guide to the density within. In some species, however, the thin wall of young corallites is fenestrated—that is to say, it consists of longitudinal thicker bands connected together by a delicate and perforate lamina; the thicker bands may be considered costæ, as they project beyond the intervening parts. In later development the wall increases in thickness, and the costæ become spinose; still later, the costæ become lost altogether, the surface-layer gradually becomes denser and is simply clothed with spinules. In such species the costulate and simply echinulate conditions coexist in different parts of the same colony, and the denser surface of the older corallites does not correspond with the primitive density of the earlier-formed layers of the wall. As growth proceeds, however, a further deposition of carbonate of lime takes place *beneath* the surface of the corallum, so that a branch which is quite porous near its apex may become nearly solid towards the base.

Before leaving this subject, it appears desirable to discuss shortly the application of the term costæ in the case of *Madrepora*. The porous corallite-wall is essentially composed of synapticulæ, and is therefore not a theca, as it differs both in structure and origin. In thecate *Madreporaria*, and, indeed, in non-thecate types also, it is usual to apply the term “costæ” to the longitudinal ridges which mark the outer surface of the wall. In the majority of cases the costæ correspond in number and position with the septa, and are usually regarded as the distal extremities of septa which pass beyond the thecate wall. If G. v. Koch’s theory of the origin of a theca is correct, and considerable evidence has already been collected in its favour, the costæ should morphologically be considered as the distal parts of septa. In the genus *Madrepora* the so-called costæ undoubtedly do not come under this category. They bear no regular relation to the septa either in number or position, and in point of time appear before the septa and are also present on the walls of corallites in which never more than two septa occur. Under these circumstances it does not appear desirable to continue the use of one term for two perfectly distinct structures, and in the systematic descriptions I have endeavoured to indicate the condition of the wall by the use of such terms as fenestrate, striate, striato-echinulate, rugose, &c.

It is often stated as characteristic of *Madrepora* that the directive septa (*cf.* p. 11) are more prominent than the other primary septa; but this is by no means always the case, nor is that condition confined to the genus. In *Madrepora* one frequently finds that in radial corallites the outer directive septum is broad and the other five primaries narrow and equal. In other species the primary septa of both axial and radial corallites are of equal breadth, in which case the bilateral arrangement of parts in the polyp is not indicated by the relative importance of the directive septa. Again, in some specimens the six primary septa of the axial corallites may all meet together in the axial fossa and fuse together so as to form a false columella; in other specimens only the directive septa become confluent. In *Anacropora* and *Montipora* the relative importance of the primary septa is subject to similar variations to those which occur in *Madrepora*. In *Anacropora* the corallites are prominent, and the branches resemble those of *Madrepora* so closely that it is not until the absence of an axial corallite is observed that the generic distinction is realized. In this genus the directive septa

are, as in *Madrepora*, usually broader than the others. In *Montipora* the septa are sometimes all more or less rudimentary and trabeculate, but in some species they are undoubtedly lamellar, and the directive septa may then be very broad or may even become fused together in the middle line. A bilateral arrangement of parts is thus as well-marked by the directive septa of *Anacropora* and some species of *Montipora* as in *Madrepora*.

Colony-formation.—Ridley in 1884* discussed the mode of budding in *Madrepora* and *Montipora*, and considered that there is a fundamental difference between the two types, dependent on the terminality or non-terminality of the distal corallite. He pointed out that *Isopora*, Studer, a subgenus of *Madrepora*, is not without axial corallites as had been supposed, but that it is provided with several instead of one. In both *Madrepora* and *Montipora* there is a more or less abundant trabeculate cœnenchyma. In *Madrepora* the budding is centrifugal, *i. e.* new buds arise below the axial corallite. In *Montipora* the apex consists of undifferentiated cœnenchyma and new buds are added above those existing, *i. e.* centripetally. He compared the condition to determinate or indeterminate inflorescence. The mode of budding in *Anacropora* is the same as in the genus *Montipora*. Ridley therefore suggests the foundation of two subfamilies, Madreporinæ and Montiporinæ, with characters based on this distinction. The terms centrifugal and centripetal do not appear to express accurately the precise modes of budding to which they are applied, and it would probably have been better had Ridley employed the botanical terms determinate and indeterminate to express the distinction in the case of branching species. In foliate species of *Montipora* the budding is centrifugal, not centripetal, seeing that new corallites are added at the periphery. In branched specimens of *Madrepora* the buds arise around, and are indirectly connected with an elongate corallite forming the axis of each branch, and extending from its point of origin to the apex, where it always projects more or less. This corallite, often spoken of as the parent corallite, is usually of larger diameter than the others, and often exhibits a better-developed series of septa. It is usually termed the apical corallite ("Endkelche" by the Germans), but axial corallite seems much more appropriate; the part of it which is "apical," and recognizable in surface-view, is only an insignificant part of its whole length.

Although the types of budding indicated by Ridley form an essential distinction between *Madrepora* and *Montipora*, the type characteristic of *Madrepora* is confined to branches formed by the living colony during its growth; in other situations the buds are formed in a similar manner to those of *Montipora*. In specimens which form incrustations (and all are incrusting in the first instance), new corallites are added peripherally from an undifferentiated mass of tissue which projects beyond existing corallites. It is only when certain of the corallites increase in length and thickness, and indicate the first formation of branches by the development of buds around them, that the form of budding characteristic of *Madrepora* comes into operation. Frequently both types of budding take place at the same time in one colony; the one leads to branch-formation, the other to marginal or basal extension. One not infrequently meets

* "The Classificatory Value of Growth and Budding of the Madreporidæ," Ann. Mag. N. H. 1884, vol. xiii. pp. 284-291, pl. xi.

with specimens in which a colony of a younger generation forms an incrustation over the branches of a dead colony of the same species. In such cases new corallites are added from a marginal mass of undifferentiated tissue until the apex of the dead branch is reached, and only later, when independent growth begins, is the mode of budding changed. It also seems probable that the immersed corallites which frequently occupy the lines of fusion between adjoining branches are formed by the primitive and not by the specialized mode of budding. A further point remains to be noticed, which appears to me important. As a result of the peculiar mode of budding in the genus *Madrepora*—which leads to the formation of a type of colony termed “patrio-ramose” by Dana—there is no cœnenchyma in the true sense of the word, excepting at points where the colony is incrusting. The radial corallites are arranged on the branches at variable intervals, and the space between them is usually considered to consist of cœnenchyma; but these intervals really form part of the thickened wall of the axial corallite around which the radial corallites are developed, and the trabecular network of which they are composed is not precisely comparable with the interzoooidal cœnenchyma of *Turbinaria*, for example, which is a true secretion of interzoooidal tissue, and not of the walls of the zooids themselves.

The Septa and their Relation to Tentacles.—The number of septa present in the corallites of the various species is, within certain limits, subject to considerable variation. The typical number may be regarded as 12, viz., 6 primary ones and 6 of a second cycle, which is usually less developed. Quelch recorded that in *M. mirabilis*, Quelch, certain of the corallites possess a third cycle of septa, making 24 in all. This has hitherto been the only instance on record of the occurrence of a third cycle of septa in the genus *Madrepora*. I am now enabled to add 2 or 3 other species to the list, and it is of interest to note that the third cycle is present usually, but not invariably, only in certain of the corallites which are nearly or completely immersed. It appears reasonable to expect the polyps in such cases to be provided with 24 instead of 12 mesenteries, and it would be interesting to ascertain the precise manner in which the additional mesenteries are formed.

The septa are generally most fully developed in the axial corallites, but even there the number in many species never exceeds 6. In other cases 2 or 4 of the second cycle may be present, but by far the greater number of species have the second as well as the primary cycle complete in the axial corallites. The members of the primary series may be equal or subequal, or more rarely the directive septa may be more prominent than any of the others. In the radial corallites there is almost every variation from the apparent absence of septa to a development as complete as that of the axial corallites or in certain cases even more complete. The usual order of development is that the directive septa appear first, then the remaining members of the primary series are added, usually but not always simultaneously. Of the second cycle one may frequently note the presence of two septa—one on each side of the outer directive—before the others appear; and in other cases there may be three or four before the final stage is reached. A third cycle of septa, in the rare instances in which it occurs, is usually confined to radial corallites, but in one species occurs in the axial corallites. Whilst in axial corallites the most usual arrangement is for the primary septa to be subequal,

in the radial corallites the directive septa are most frequently better developed, either stouter or broader, than the other primaries. In certain groups of species, however, the outer directive septum is more important than the inner; and in case only one septum is present it is invariably the outer directive. Apparently the number, but more particularly the relative importance, of the septa form characters of value for the classification of species. In several of the subdivisions now proposed the species were first associated together on general grounds, and without any regard to the condition of the septa; and yet, in almost every case, the relative importance of the septa will be found nearly constant—e. g., *Lepidocyathus* and *Trachylopora*. In certain species there appear to be two types of radial corallites. In the usual more or less prominent one the septa are naturally least developed in the young buds near the apex, and there is a gradual increase in importance in older corallites until the normal condition is attained. It may be that the condition of the septa is subject to little variation whether the corallite be prominent or immersed, situated near the apex or near the base of the corallum. In certain species, however, some of the immersed corallites of the upper surface of the corallum have quite a different development of the septa to the prominent ones. Sometimes the septa in these immersed corallites are more numerous or better developed—a condition which might be attributed to age; but that this is not always the case is clear from the fact that such corallites often contain more septa than the axial corallites, or, on the other hand, may show an almost complete absence of septa. Similarly, prominent corallites on the under surface of prostrate or vasiform specimens may show a condition of the septa quite distinct from that characteristic of the upper surface.

Whether in the case of the axial corallites the relative importance of the directive septa is usually associated with a variation in the size of the tentacles situated over them is not known. In Dana's figures of the axial polyps of *M. cribripora* and *M. aspera* the tentacles are shown of equal length. In Agassiz's 'Florida Reefs' the polyps of *M. cervicornis* and *M. prolifera* are figured, and in both cases the tentacles are drawn alternately large and small, corresponding evidently to the broader primary and narrower secondary septa. This arrangement is in accordance with Lacaze-Duthiers's figures of the embryo of *Astroides*. Mr. Saville-Kent informs me that in his experience of the Torres-Straits and Barrier-Reef species the tentacles of the axial polyps are always of equal length, even in species in which this does not hold good for the radial polyps. So far as I am aware, Dana does not anywhere state the *usual* condition of the tentacles of the radial polyps in *Madrepora* in the living specimens which came under his notice. There seems reason to suppose that they were generally of equal size, from the fact that he figures them as such without comment in the case of *M. aspera*. With regard to *M. prostrata* he calls special attention to the fact that one of the tentacles is much longer than the others, and that this is situated over the outer directive septum, which is itself broader and stouter than the remaining septa. That this arrangement was not usual in his experience will be rendered clear from the following quotation:—"Among the species of *Madrepora* there are some in which one of the tentacles of the polyps is long and flexible. This was observed in a cespitose species (*M. prostrata*) having thin labellate calicles; but whether it belongs or not to all the horizontally-growing

species with similar calicles remains to be determined. This character may hereafter lead to a subdivision of the genus and a separation of the species having labellate calicles (*M. conigera*, *efflorescens*, *cytherea*, *spicifera*, *hyacinthus*, *surculosa*, *millepora*, *prostrata*, *subulata*, *turbinata*, and *convexa*) as a distinct group."

In Agassiz's 'Florida Reefs' the radial polyps of *M. cervicornis* are represented as possessing one tentacle which is longer and stouter than the others; the arrangement of the septa is only represented in the axial corallites. I find from an examination of a number of specimens that the outer directive septum is sometimes, but not always, broader than the inner; both directives are broader than any of the other septa. In the case of *M. prolifera* Agassiz's figure shows the radial as well as the axial polyps to have the tentacles arranged in two cycles, alternately large and small. It appears questionable whether this figure is correct: in any case it is not a good one, and apparently not drawn with the same view to minute detail which characterizes nearly all the other figures—which are, indeed, the best lithographic representations of Madreporaria which have come under my notice. My doubts as to the accuracy of the figure in question are further based on the following considerations:—(1) I do not consider *M. prolifera* specifically distinct from *M. cervicornis*; (2) the septa of the radial corallites have the same relative importance and are subject to the same variations as in *M. cervicornis*; (3) there is apparently no other recorded instance of the alternation of long and small tentacles in the radial polyps of any species belonging to the genus.

I conclude, from the general remarks of Klunzinger on the structure of *Madrepora*, that he regards the presence of an elongate tentacle in the radial polyps as a usual condition; and he does not mention any other arrangement. After calling attention to the fact that the outer part of the wall ("Rückenwand") is usually better developed than the inner ("Bauchwand"), he refers to the association of this condition with two broad septa, which divide the corallite bilaterally. He then goes on to state that, associated with this condition, we find one of the tentacles corresponding to one of the principal septa broader than the others, but that this only occurs in such bilateral corallites. In the descriptions of the Red-Sea species he only refers twice to the occurrence of an elongate tentacle, viz. in *M. corymbosa* and *M. cytherea*. In the former instance he refers to the colour of the *long tentacle* in a manner which appears to indicate that in his opinion such a long tentacle is of general occurrence amongst the species of *Madrepora*. Mr. Saville-Kent has kindly shown me proof copies of the plates illustrating his forthcoming work on 'The Great Barrier Reef of Australia,' which contain figures of the radial polyps of *M. prostrata* and *M. hebes*, and in each case an elongate tentacle is shown. This, so far as I am aware, completes the list of species for which the condition of the tentacles has been recorded. All the species which are known to have one tentacle larger than the others, excepting *M. cervicornis*, belong to the group indicated by Dana. The absence of *M. hebes* from Dana's list is probably to be accounted for by the fact that he paid more attention to habit than to the form of the corallites in assigning the species its position in his classification. The radial corallites of *M. hebes* are not, strictly speaking, labellate; but the term is used in a much wider sense in Dana's work than in the present

one, and the corallites of *M. hebes* agree in form with those of *M. millepora*, *M. prostrata*, &c., and not with *M. cytherea* and allied forms. The absence of *M. corymbosa* from Dana's list will also be noted. Doubt has already been cast on Dana's identification of *M. corymbosa*, Lamk.; and the fact that he did not associate *M. corymbosa*, Dana, with *M. cytherea* in the list quoted lends further support to the view that Dana's species is not identical with that of Lamarck.

Whether the radial polyps of *M. aspera*, which have equal tentacles according to Dana's figure, differ structurally from those of *M. prostrata* is not at present known. The account given by Fowler of the structure of *M. aspera* probably refers to the species *M. pocillifera*, which is, however, closely allied, and is here regarded as a member of the same group. A fragment of the material has been kindly placed at my service by Dr. Fowler, and I find that it agrees closely with the 'Challenger' specimens of *M. pocillifera*. The only other species studied by Dr. Fowler does not belong to the same group as *M. prostrata*, so that we have at present no means of comparison. It appears, however, probable that certain types of arrangement of the septa are associated with morphological differences in the polyps which produce them; and a fuller knowledge of the structure of the soft parts will doubtless supply valuable data for the purpose of classification. I may, however, point out that for this purpose it is not sufficient to indicate general structure; it will be necessary to give details for the axial corallites, for the prominent radial corallites, and also for the immersed or other forms which may differ from the usual type.

Structure of the Polyps, and the Relation of Soft Tissues to the Skeleton.—Fowler* has studied the anatomy of two 'Challenger' species of *Madrepora*, in one of which a new and interesting type of dimorphism occurs. The present section consists of a summary of his results, together with a few supplementary observations of my own.

The external body-wall consists of the usual three layers—ectoderm, mesogloea, and entoderm,—and is supported on echinulations or rugæ both on the radial corallite-walls and in the inter-corallite regions, where the latter are of sufficient importance to possess independent supports. Under the external body-wall and between the rugæ (*M. pocillifera*) a series of external longitudinal canals exist, which open into each other and also through the corallum into a series of internal canals with radial and transverse connections; these, in turn, communicate with the general coelentera of the polyps, and all communicate eventually with the coelenteron of the axial polyp. These canals occupy the channels in the corallum already described. The structure of the polyps is, in its general features, Actinian, but there is a marked bilateral arrangement of parts. The mouth-disk, with its fringe of twelve tentacles, is capable of retraction within the fossa of the corallite. In vertical section of a contracted polyp the soft tissues form a funnel-shaped structure similar to that seen in *Alcyonium* under similar conditions. The mouth is elongated in the sagittal axis. The stomodæum, which occupies the central portion of the coelenteron, is supported by twelve mesenteries, which, however, differ in importance. The extremities of the stomodæum are

* "Anatomy of the Madreporaria.—Part II.," Quart. Journ. Microsc. Science, vol. xxvii. (1886) pp. 1-16, pl. i.

supported by the directive mesenteries, and the interval between these by four mesenteries on each side. The directive mesenteries and one mesentery on each side (nos. 4 and 9 of Fowler's figure 8)—which, as in Antipatharia, may be termed the transverse mesenteries and are the first to be developed—are more important than the others and extend to a lower level. The transverse mesenteries are the longest, and are the only ones which bear reproductive organs. Similar elongate mesenteries occur in Alcyonaria, in Antipatharia, and in *Seriatopora* and *Pocillifera* amongst the Madreporaria. In Antipatharia, as in *Madrepora*, they are the only ones which bear reproductive organs. The free extremities of the longer mesenteries bear a trilobate mesenterial filament. The retractor muscles of the mesenteries are arranged on the hexactinian plan—that is to say, they occur on the outer surfaces of the directive mesenteries and on the inner surfaces of all the other so-called pairs. If we use Fowler's terminology, the primary septa are entocœlic in position, and the secondary cycle exocœlic. I have elsewhere* suggested the use of the term amphicœlic for bilateral types, and that term is probably preferable in this case. If the primary septa are prominent, each septum causes a fold to be formed in the wall of the stomodæum in which its distal extremity is lodged. Presumably in cases where the directive septa or all the primary septa meet in the middle line and become fused together, the stomodæum may be divided into compartments. With the development of a septum the members of a so-called pair of mesenteries become pushed further apart, so that in transverse sections of decalcified specimens which possess no well-developed septa of the second cycle the entocœles are very broad and the exocœles narrow.

The case of dimorphism is recorded by Fowler to occur in *M. durvillei*. I have stated elsewhere my reason for believing that the species is a variety of *M. tubigera*. In any case it is identical with the fragments recorded by Quelch in the 'Challenger' Reef Corals under the name *M. capillaris*, Klunz. In the species in question there are two types of polyps, both of which appear to be irregularly distributed. The one type is quite normal in structure, but the other (type A of Fowler) has six of the mesenteries (viz. the axial directives and alternate septa afterwards) much thickened. These septa (nos. 2, 4, 6, 7, 9, and 11 of Fowler's fig. 8) bear a tube lined by epiblast, which forms a U-shaped canal opening at both ends into the stomodæum. Such polyps are charged with symbiotic algæ. This type of polyp appears more digestive than the normal one; but both are also reproductive, although the specialized type bears very few ova.

CLASSIFICATION.

The classification of the species of *Madrepora* proposed by Dana is based primarily on habit, whilst the form and condition of the radial corallites afford the necessary characters for further subdivision. Seven principal divisions are enumerated, with the following characters :—

* "Notes on the Affinities of the Genus *Madrepora*," Proc. Linn. Soc. Lond., Zool. 1893.

- A. Corallum horizontal or obliquely foliate, without proper branches above.
- B. Corallum horizontal or oblique, with erect or ascending branches above, forming clumps with concave or convex top—vasiform or cespitose.
- C. Corallum fastigiate; branches erect, much or closely subdivided; corallites short and round nariform.
- D. Corallum arborescent; branches evenly covered with proliferous branchlets and clusters.
- E. Corallum arborescent or fruticose; branches either not proliferous or unevenly so.
- F. Corallum consisting of a few long stems from a common base, simple or rarely branched.
- G. Corallum composed of erect plates in place of proper branches; no distinct apical corallite.

Milne-Edwards and Haime divide the genus into two sections—Fasciculatæ, with radial corallites, and Distichæ, with lateral corallites; only one species is referred to the latter section. The Fasciculatæ are divided into five primary divisions, based chiefly, but not entirely, on habit:—

- A. Corallum arborescent; corallites short or moderately prominent, not elongate and spiniiform.
- B. Corallum arborescent; corallites tubular and very long.
- C. Corallum cespitose, in the form of rosettes or tufts, rounded above.
- D. Corallum corymbiform or subvasiform.
- E. Corallum foliaceous and little proliferous.

The divisions A and B correspond roughly, but not exactly, with Dana's divisions E, C, and D respectively. The divisions C and D correspond similarly with Dana's division B; whilst E is formed by the fusion of divisions A and G of Dana. The plan on which Milne-Edwards and Haime subdivided these main groups is, however, quite different from that of Dana. The form of the radial corallites is rarely employed, but instead the next smaller groupings depend on the condition of the cœnenchyma, the degree to which the branches coalesce, the incrusting or pedicellate character of the base, &c. The subdivision need not be followed further for present purposes.

Klunzinger, in his studies of the Red-Sea Corals, has adopted quite a different classification of the species of that region, though it is questionable whether he would not have considerably modified his system, had it been necessary to include all the described species. The following table gives the main features of his scheme:—

- A. Axial corallites 4 to 6 mm. diameter.
 - a. Aperture of radial corallites central, margin more or less rounded above; wall echinulate or granular, not striate.
 - b. Aperture of radial corallites oblique.

- B. Axial corallites 3 to 4 mm. diameter.
 - a. Axial corallites hemispherical or short cylindrical, 1 to 2 mm. exsert.
 - b. Axial corallites long cylindrical, 3 to 5 mm. exsert.
- C. Axial corallites 2 to 3 mm. diameter, short cylindrical or hemispherical.
- D. Axial corallites 2 to 3 mm. diameter, long cylindrical, 3 to 6 mm. exsert.

It will be seen that divisions C and D correspond to the two sections of division B, excepting that the axial corallites have a smaller diameter.

The only other form of classification which need be noticed is that adopted by Ortmann, which to some extent is a compromise between those of previous authors. Ortmann, in his paper on the Corals of the Strassburg Museum, discusses shortly the classifications of previous authors, and considers that of Dana preferable to that of Milne-Edwards and Haime; in this I agree with him. The arrangements of species which he adopts, both in the paper referred to and in the later one on the Ceylon Corals, were, like Klunzinger's, evidently only intended as an aid to the identification of the species recorded in the respective papers. Ortmann follows Dana in his main divisions, excepting in one or two cases, in which I think his system appears to lose rather than gain by the change. In his subdivision of the main groups, however, he appears to have selected characters which in many cases bring together groups of species which are undoubtedly closely related. For instance, in considering those species with axial corallites of a given diameter, he distinguishes between those which are cylindrical and those which have a thick wall and rounded margin. Again, the corymbose species are divided into two sections: in the one the branchlets are "catkin-like" ("kätzchenförmig"), with spreading scale-like corallites; in the other the branchlets are what Dana termed "spiciform."

It may be well to consider separately the various characters which have from time to time been employed in a subdivision of the genus *Madrepora*, and endeavour to ascertain their present value for the purpose. In doing so it must, however, be distinctly understood that it is premature to attempt a classification based on the morphology of the polyps; and the only characters at present available depend on the variation of the corallum and the corallites which compose it, together with such guesses at the conditions by means of which these structures are produced as may appear to receive support from the evidence already obtained.

1. *Habit*.—In certain cases allied species have undoubtedly a similar habit: compare, for instance, the various species referred to *Lepidocyathus* and the majority of those referred to *Tylopora*. Again, the majority of the truly arborescent species seem closely related to one another, though others which are not arborescent probably belong to the same group. From a consideration of habit alone Dana would not have arrived at his section G, which was founded to include *M. labrosa*, *M. securis*, and *M. cuneata*, otherwise he would have included *M. palmata*, *M. cyclopea*, and possibly *M. conigera*. This was done by Milne-Edwards and Haime, and the artificial result attained by the consideration of habit alone is at once realized. Dana's group G remains good to-day and received the name *Isopora* from Studer; the essential feature of the group is not made clear in the definition, but that is a point

which need not be considered now. To take another instance: Dana included *M. echinata*, *M. rosaria*, and *M. florida* in his group D. These three species appear to me to differ in so many points from each other that they have been referred to three different subgenera. Even for specific purposes it is doubtful how far habit forms a reliable character. Dana points out that the habit of a specimen is to some extent dependent on its situation. He states (p. 434):—"The cespitose species appear to vary in shape somewhat according to the depth at which they grow. In those near the surface the branches spread more nearly horizontally and are consequently more crowded and more completely coalescent; whilst those at greater depths have a more ascending mode of growth and the less coalescent branches appear longer and more subdivided." Klunzinger noted in the Red Sea the extreme variability of *M. corymbosa* and other species. Pourtalès also, taking note of the difference in the relative exposure of *M. palmata*, *M. cervicornis*, and *M. prolifera*, on the West Indian Reefs, hinted that the three species of Lamarck may prove to be variations of one species, dependent on environment for their precise habit. Such is the opinion I have arrived at after comparison of a very large number of specimens, although it must be admitted I have no precise information as to environment.

2. *Form of the Radial Corallites*.—The form of the radial corallites is subject to considerable variation, in many cases even in different parts of the same colony; but, as Klunzinger has already pointed out, in every species the variation takes place on a fixed plan, so that each species has its own particular type of corallite, or combination of such types. The character of the corallites appears, however, to enable one to distinguish species rather than groups, and if applied to divisions based on habit it undoubtedly breaks down. Dana's division A may be taken as an illustration. *M. palmata*, Lamk., and *M. cyclopea*, Dana, are placed in one section, characterized by a tubular form of corallite, whilst *M. conigera*, Dana, occupies another section, characterized by the presence of labellate corallites, *but also by the occurrence of numerous incipient branches scattered over the surface of the corallum*. In *M. palmata* and *M. cyclopea* labellate corallites are of frequent occurrence, and in certain forms of the former constitute by far the greater portion of prominent corallites. Thus in this case it is not the form of the corallites but the occurrence of conical incipient branches on the surface which forms the important distinction; and even then *M. cyclopea* occupies an intermediate position between *M. palmata* and *M. conigera*. In another case Milne-Edwards and Haime associate together such diverse species as *M. echinata*, *M. tubulosa*, and *M. cuspidata* in a group characterized by the presence of very long tubular corallites.

3. *Condition of the Surface of the Corallum*.—In the genus *Madrepora* one may distinguish two principal groups of species—the one characterized by the presence of marked costulæ on the corallite-wall and of an open network between the radial corallites, the other by an extremely compact or almost solid surface clothed with delicate echinulations; but innumerable intermediate conditions occur. Doubtless the condition of the surface does reflect to some extent the physiological activity of the living colony and as such must be regarded as a character of value, but only when associated with other characters. In practice it is found extremely difficult to make important use of such a character, partly because the surface is

subject to variations dependent on the rate of growth &c. of the particular specimen, and in many cases the normal surface is hidden by a secondary deposit; and partly because the actual density of the corallum is usually increased with age by the secondary deposition of lime.

4. *Degree of Coalescence of Branches.*—This is a feature which appears to me to be of little value unless associated with other characters. Even in species which at a late stage of colony-formation exhibit a network of branches, or where the main branches become fused into a solid mass, there is no doubt that at an early stage such confluence did not occur. For example, there are several specimens of *M. efflorescens* in the collection of the British Museum. The oldest forms a solid vasiform plate in which confluence of the main branches takes place quite to the margin of the colony; the youngest has obliquely radiating, non-confluent branches with the habit characteristic of *M. prolifera*, Lamk. Again, the types of *M. fragilis*, B.-Sm., and *M. rambleri*, B.-Sm., differ only in the latter being an older colony than the former; and owing to the manner in which the branches extend, they are bound to become confluent if growth goes on long enough. Evidently, then, the coalescence or non-coalescence of branches is an unreliable character, when taken alone, even for specific purposes.

5. *Incrusting or Pedicellate Conditions.*—Little need be said under this head: apparently all species of *Madrepora* are incrusting in the first instance, and the extent to which incrustation takes place is, in some cases at any rate, dependent on environment rather than on the habit of the species or group of species. Large incrusting masses occur of species which usually form cespitose or even arborescent colonies. The pedicellate condition has also been already recognized as not constant in certain species.

6. *Size and Form of the Axial Corallites.*—These characters were first used by Klunzinger and afford valuable assistance in the grouping of species. I am, however, of opinion that size alone is of little value. In the primary sections of Klunzinger's system based on size one often has difficulty in fixing the position of a species owing to the fact that the dimensions vary beyond those of the section. It would not be difficult in the case of certain species to find in one specimen some axial corallites which have the dimensions of one section and others of another. Evidently the divisions 4–6 mm., 3–4 mm., &c. are quite artificial and, though convenient for Klunzinger's purpose, cannot be made use of in a general classification.

With regard to the characters which in the present treatise are regarded as the most reliable for the subdivision of the genus, I have already stated that for the present any attempt at a classification of the *Madrepore* must be based primarily on the *structure of the corallum*. This, however, does not preclude an attempt to take into consideration the structure and arrangement of the soft tissues in their relation to the corallum so far as these are known, and from the basis thus obtained to endeavour to distinguish skeletal characters which may be the outcome of a difference in structure or arrangement. For instance, in *M. cervicornis*, Lamk., the corallum is openly reticulate in

section and the walls of the corallites are provided with prominent costulae, between which, there is every reason to suppose, the longitudinal canals described by Fowler are situated. In *M. hemprichi*, on the other hand, the corallum is much denser in section, the wall is not costulate, but very finely echinulate instead; and one may presume the absence of costulae to necessitate, or rather to be the result of, a different arrangement of the extra-calicular tissues. Evidently, then, if *M. cervicornis* and *M. hemprichi* differ in other skeletal characters, one appears justified in placing them in different sections. I have assumed that a similarity of structure involves a close relationship and have therefore, in the classification now proposed, placed little reliance on habit. To a certain extent the species now described fall into well-marked groups, if one does not regard habit as of prime importance. For instance, Studer's subgenus *Isopora*, although connected with the arborescent types through such species as *M. brüggemanni* and *M. ortmanni*, appears sufficiently isolated to justify its separation. The species *M. echinata*, Dana, agrees with *M. echidnaea*, *M. subglabra*, *M. longicyathus*, *M. speciosa*, and *M. horrida* and others in the possession of a type of slender tubular corallite not found outside the group. The nearest approach to this condition is found in another group of species, *M. tubulosa*, *M. rosaria*, *M. hydra*, *M. confraga*, &c., characterized by the presence of a thick-walled rod-like corallite with more or less rounded apex. Again, a considerable number of species, agreeing more or less in habit, group themselves around *M. seriata*, Ehrb., in the possession of a very thick and porous-walled axial corallite, which is hemispherical or very slightly prominent at the margin. Whether such divisions are well founded or not remains to be determined, but in any case they appear to be more convenient than those previously proposed. I have thus to a considerable extent made use of the form &c. of the axial corallites in many of the divisions now proposed, but in other cases, where the resulting groups appeared too extensive, I have made use of other characters. A considerable number of corymbose species have a short cylindrical type of axial corallite, which varies very little in different species, not even to any considerable extent in diameter. Some have delicate, curved, scale-like radial corallites, others labellate or nariform ones. The one type gives the catkin-like appearance to the branchlets referred to by Ortmann, the other the spiciform type of branchlet. *M. millepora*, Ehrb., will serve as an illustration of the former group, and *M. spicifera*, Dana, of the latter. If, however, one endeavours to realize the type of radial corallite present in *M. millepora*, irrespective of its length, and then looks around to see if this type occurs in any other species, it is found at once that in *M. hebes*, Dana, *M. monticulosa*, Brüggemann, and a number of other species, which differ entirely from *M. millepora* in habit, the same type of corallite occurs. In such cases I have regarded unity of type in the radial corallites as of more importance than habit for systematic purposes. If such an arrangement serves to facilitate the identification of species its purpose will have been fulfilled. It appears more convenient to use names to distinguish the chief divisions, but I have not at present felt justified in considering them of generic value, although some appear to merit that distinction.

DESCRIPTIVE PART.

MADREPORA.

Millepora (part.), Linnaeus, Syst. Nat. ed. x. p. 790.

Madreporce anomalæ (part.), Pallas, Eleuchus Zoophytorum, p. 279.

Madrepora (part.), Linnaeus, Syst. Nat. ed. xii. p. 1272; Esper, Pflanzenth. i. p. 61; Ellis & Solander, Zoophytes, p. 145; Lamarck, Syst. Anim. sans Vert. 1801, p. 371.

Madrepora, Lamarck, Anim. sans Vert. 1816, t. ii. p. 277 (pro parte).

? *Porites* (part.), Ehrenberg, Corallenth. d. roth. Meeres, p. 113; Lamarck, op. cit. p. 267.

Astræa (part.), Lamarck, op. cit. p. 257.

Oculina (part.), Lamarck, op. cit. p. 283.

Heteropora, Ehrenberg (*non* Blainville), Corallenth. d. roth. Meeres, p. 106.

Madrepora, Dana, M.-Edwards & Haime, and all subsequent authors

Definition.—Perforate Madreporaria in which independent colony-formation takes place by means of indirect budding around the wall of an axial corallite, which, by increase in dimensions, becomes a branch. Further subdivision takes place when any of the radial corallites, produced as buds, assume the characters of an axial corallite. A prominent corallite-wall is never entirely wanting, but may, in certain cases, be confined to those corallites situated near the apex of a branch. The corallites are, in typical cases, provided with 12 septa, arranged in two cycles of 6 each. In a few instances a third cycle of 12 septa may be present; but such a condition is, so far as known, confined to certain corallites, and is not common to the whole colony. On the other hand, in some species the second cycle is not developed, and in other cases the septa of the radial corallites may be reduced to two or even to one. A true columella is absent; but in case the septa are well-developed, two or more of the primary series may become confluent. Only one species is known in which the septa are exsert, and in that case the feature is confined to immersed corallites. The polyps are provided with 12 tentacles and 12 mesenteries (presumably with more in case there are more than 12 septa). They exhibit a marked bilateral arrangement of parts, which is frequently indicated in the corallites by the greater development of an outer and often also of an inner septum, each of which corresponds with an extremity of the elongate

stomodæum, and is situated between a pair of directive mesenteries. This condition is, however, not characteristic of the genus (*cf.* p. 10).

Further information regarding the structure of the polyps and the relation of the soft tissues to the skeleton will be found on p. 14.

With the exception of the peculiar mode of colony-formation, first clearly recognized by Ehrenberg, none of the characters hitherto included in the definition of the genus are absolutely constant throughout or confined to it.

Synopsis of the Subgenera.

DIVISION I.—*Madreporæ* with cylindrical axial corallites, which project to a greater or less extent at the apex of each division of the corallum; wall usually very porous, margin plane, exterior more or less distinctly striate or rugose.

1. Corallum usually arborescent. Axial corallites 2.5 mm. diameter or over, with relatively thin wall and 12 septa, the primaries being subequal. Radial corallites usually with a distinct star of 12 septa EUMADREPORÆ, p. 23.
2. Corallum more or less complanate. The second cycle of septa is absent or imperfectly developed even in axial corallites. The majority of the radial corallites are usually immersed or subimmersed; the more prominent ones have the wall acuminate ODONTOCYATHUS, p. 66.
3. Corallum usually cespitose or corymbose. Branchlets more or less distinctly spiciform. A second cycle of septa occurs in axial corallites. Radial corallites with not more than the inner third of the wall undeveloped POLYSTACHYS, p. 73.
4. Corallum usually corymbose or prostrate. Radial corallites evenly distributed, scale-like, very spreading, giving a catkin-like appearance to the branchlets. The outer directive septum of radial corallites is usually better developed than the others LEPIDOCYATHUS, p. 115.

DIVISION II.—*Madreporæ* in which the axial corallites are stout, thick-walled, often hemispherical, not exsert at the margin, or only slightly so; wall dense, rarely striate.

1. Corallum consisting of massive plates, the upper border of which is occupied by numerous axial corallites, which are slightly exsert and have a rounded margin ISOPORA, p. 131.
2. Corallum cespitose, corymbose, or bushy. Branchlets blunt at the apex. Axial corallites relatively broad, hemispherical, or slightly exsert at the margin TYLOPORA, p. 135.

DIVISION III.—Axial corallites relatively slender, conical or cylindrical, in the latter case of considerable length; wall always dense. Many of the radial corallites resemble the axial ones in form.

1. Corallum differing chiefly from that of *Tylopora* in having more slender apices to the branchlets and relatively small conical axial corallites CONOCYATHUS, p. 160.
2. Axial corallites cylindrical, the prominent portion not usually longer than broad; wall thick and dense, margin rounded. A second cycle of septa is present RHABDOCYATHUS, p. 173.

3. Axial corallites slender, elongate, cylindrical; margin plane or suddenly contracted, not rounded. Wall thin but dense. A second cycle of septa is not present. TRACHYLOPORA, p. 184.

DIVISION IV.—Axial corallites more or less distinctly compressed, giving rise to flattened branches, with the most prominent corallites confined to the lateral margins.

DISTICHOCYATHUS, p. 192.

DIVISION I.

1. Subgenus EUMADREPORA.

This section of the genus includes the majority of the arborescent species, together with others in which the original ramose condition is lost by fusion of adjacent branches. The species of the *cyclopea* group form massive lobes or plates; but the characters of the axial and radial corallites show an affinity to *M. muricata* f. *palmata*. Unless the branches are confluent quite to the apex the axial corallites are 2.5 mm. exsert or more. The radial corallites are rarely immersed on the distal divisions of independent branches, and the form varies from nariform either through tubo-nariform to tubular, or through half-tubular to labellate and dimidiate. The axial corallites possess a star of 12 septa, of which the primaries are subequal. In the radial corallites there are also usually 12 septa, unless in young corallites; but the directive septa are generally more prominent than any of the others. Corallum usually reticulate in section. A number of slender arborescent species have been provisionally included in the first section of the subgenus which show an affinity with the *tubigera* group referred to *Polystachys*. The subgenus is also related through *M. crassa* to the *nobilis* group of *Tylopora*, and to *Lepidocyathus* and *Odontocyathus* through the *pocillifera* group.

A. *Prominent corallites subequal, nariform or tubo-nariform, more rarely some are labellate. The radial corallites rarely bear buds unless in situations which indicate new out-growths.*

a. *Corallum arborescent; branches terete, rarely coalescent, but in one variety of M. muricata become fused together into plate-like or vasiform specimens.*

* *Branches over 1 cm. diameter.*

1. *Madrepora muricata*.

Millepora muricata (part.), Linnæus, Syst. Nat. ed. x. p. 792.

Madrepora muricata (part.), Linnæus, Syst. Nat. ed. xii. p. 1279; Pallas, Elenchus Zooph. p. 327; Ellis & Solander, Zoophytes, p. 171; Esper, Pflanzenth. Fortsetz. Th. i. pp. 45-59, pls. l., li., liii. ?, liv. B ?, lxxxiii.

? *Madrepora plantaginea*, Duchassaing (*non* Lamarck), Anim. radiaires d. Antilles, p. 17.

A. FORMA PALMATA.

Madrepora muricata, var., Esper, loc. cit. pls. li., lxxxiii., liv. B ?

Madrepora infundibuliformis, Esper (*non* Linn.), loc. cit. pl. li.

Madrepora crater, Esper (*non* Pallas), loc. cit. pl. li.

Madrepora palmata, Lamarck, Hist. Nat. Anim. sans Vert. t. ii. p. 278, ed. ii. p. 446; Lamouroux, Expos. méthod. p. 62; Deslongchamps, Encyclop. p. 503; Blainville, Manuel d'Actin. p. 389; Dana, Zoophytes, p. 436, pl. xxxi. fig. 11; Duchassaing, Anim. radiaires d. Antilles, p. 16; M.-Edwards & Haime, Coralliaires, t. iii. p. 160; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Pourtalès, Illustr. Cat. Mus. Comp. Zool. pt. iv. p. 83; Duchassaing & Michelotti, Mem. Accad. Torino, 1864, t. xxiii. p. 94; Duchassaing, Rev. d. Zooph. d. Antilles, 1870, p. 32; L. Agassiz, Mem. Mus. Comp. Zool. 1880, vol. vii. pl. xvii.; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 17; Quelch, 'Challenger' Reef Corals, p. 149.

Heteropora palmata, Ehrenberg, Corallenth. d. roth. Meeres, p. 108.

Madrepora flabellum, Lamarck, Hist. Nat. Anim. sans Vert. t. ii. p. 278, ed. ii. p. 447; Blainville, Manuel d'Actin. p. 390; Deslongchamps, Encyclop. p. 503; Dana, Zoophytes, p. 438, pl. xxxi. fig. 13; M.-Edwards & Haime, Coralliaires, t. iii. p. 160; Duchassaing & Michelotti, Mem. Accad. Torino, 1864, t. xxiii. p. 94; Duchassaing, Revue d. Zooph. d. Antilles, 1870, p. 32.

Heteropora flabellum, Ehrenberg, Corallenth. d. roth. Meeres, p. 108.

Madrepora alces, Dana, Zoophytes, p. 437, pl. xxxi. fig. 12; M.-Edwards & Haime, Coralliaires, t. iii. p. 160; Duchassaing & Michelotti, Mem. Accad. Torino, 1864, t. xxiii. p. 94; Duchassaing, Revue d. Zooph. d. Antilles, p. 32; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 17; Ortmann, Zool. JB. 1888, Bd. iii. p. 148 (*non* Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 576).

Madrepora cornuta, Duchassaing & Michelotti, Mem. Accad. Torino, 1860, t. xix. p. 82; *ibid.* 1864, t. xxiii. p. 94; Duchassaing, Rev. d. Zooph. d. Antilles, 1870, p. 32.

Madrepora thomasiana, Duchassaing & Michelotti, Mem. Accad. Torino, 1860, t. xix. p. 82; *ibid.* 1864, t. xxiii. p. 94; Duchassaing, Rev. d. Zooph. d. Antilles, 1870, p. 32.

Madrepora perampla, Horn, Proc. Acad. Nat. Sci. Philad. 1860, p. 435.

Madrepora subaquilis, Horn, *ibid.* p. 435.

Porites cristata, Ehrenberg, MS. Berlin Museum.

B. Forma PROLIFERA.

Madrepora muricata, var., Esper, Pflanzenth. Fortsetzung, Th. i. pl. li.; ? Ellis & Solander, Zoophytes, pl. lvii.; ? Lamouroux, Expos. méthod. pl. lvii. (as *abrotanoides*, Lamk.).

Madrepora prolifera, Lamarck, Hist. Nat. Anim. sans Vert. t. ii. p. 281, ed. ii. p. 449; Blainville, Man. d'Actin. p. 390; Dana, Zoophytes, p. 480; M.-Edwards & Haime, Coralliaires, t. iii. p. 139; Duchassaing & Michelotti, Mem. Accad. Torino, 1864, t. xxiii. p. 94; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 40; Duchassaing, Revue d. Zooph. d. Antilles, p. 32; Pourtalès, Illustr. Cat. Mus. Comp. Zool. pt. iv. p. 84; L. Agassiz, Mem. Mus. Comp. Zool. 1880, vol. vii. pl. xix.; Quelch, 'Challenger' Reef Corals, p. 149; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 17 (*non* *Heteropora prolifera*, Ehrenberg, Corallenth. d. roth. Meeres, p. 112).

Madrepora ethica, Duchassaing & Michelotti, Mem. Accad. Torino, 1860, t. xix. p. 82, pl. x. figs. 7, 8; *ibid.* 1864, t. xxiii. p. 94; Duchassaing, Rev. d. Zooph. d. Antilles, p. 32.

? *Heteropora pocillifera*, Ehrenberg (*non* Lamarck), Corallenth. d. roth. Meeres, p. 110.

? *Madrepora mexicana*, Rehberg, Abh. nat. Ver. Hamburg, 1892, Bd. xii. p. 38, pl. iii. fig. 16.

C. Forma CERVICORNIS.

Madrepora cervicornis, Lamarck, Hist. Nat. Anim. sans Vert. t. ii. p. 281, ed. ii. p. 449; Blainville, Man. d'Actin. p. 390; Dana, Zoophytes, p. 479; Duchassaing, Anim. radiaires d. Antilles, p. 17; M.-Edwards & Haime, Coralliaires, t. iii. p. 136; Duchassaing & Michelotti, Mem. Accad. Torino, 1864, t. xxiii. p. 94; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 40; Duchassaing,

Rev. d. Zooph. d. Antilles, p. 32; Pourtalès, Illustr. Cat. Mus. Comp. Zool. pt. iv. p. 84; L. Agassiz, Mem. Mus. Comp. Zool. 1880, vol. vii. pl. xviii.; Quelch, 'Challenger' Reef Corals, p. 149; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 13.

Heteropora regalis, Ehrenberg, Corallenth. d. roth. Meeres, p. 111.

Madrepora regalis, M.-Edwards & Haime, Coralliaires, t. iii. p. 139.

Heteropora lava, Ehrenberg (*non* Lamarek), Corallenth. d. roth. Meeres, p. 110.

Madrepora superba, Klunzinger, Korallth. d. roth. Meeres, Th. ii. pp. 19, 20, pl. iii. fig. 1, pl. iv. fig. 5, pl. ix. fig. 15; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45; Faurot, Arch. Zool. expér. 1888, t. vi. p. 119.

Madrepora secunda, Ortmann, Zool. JB. 1888, Bd. iii. p. 150 (part.).

A. Forma palmata.

Corallum frequently flabellate or palmate; fronds large, thin, and usually solid quite to the margin, flat or curved, often several radiating from an incrusting base. Some specimens are short, stout, vasiform, with a thick pedicel and broad base, branches quite indistinguishable. The flabellate forms consist of fronds often 60 cm. long and 40 cm. or more broad, forming solid plates about 8 mm. thick at the apex and 1 to 2 cm. near the base. The fronds may be entire or divided by narrow fissures into lobes. In other cases they are alciform (*M. alces*, Dana), with the branches composing each lobe confluent quite to the apex. In the majority of specimens the branches are only recognizable near the margin of the corallum, but in some their course is indicated by furrows on the surface. Axial corallites sometimes scarcely recognizable, particularly in vasiform specimens. In other cases the marginal divisions of the branches bear axial corallites 2 to 2.5 or even 3 mm. diameter and 1 to 3 mm. exsert. Wall sometimes rather thin, but usually thick and porous, strongly striate exteriorly; the largest corallites usually occur in branches which are comparatively free near the apex. Radial corallites prominent on both sides of the frond or only on the upper one. Prominent radial corallites tubular, with a more or less oblique aperture; sometimes half-tubular, labellate, or nariform, often unequal in length, 1 to 4 mm. or even 5 mm., and 1 to 2 mm. thick, but usually between 1.5 mm. and 1.8 mm. They arise at an angle of about 45° on the branches, but in the flabellate portion are more spreading, frequently at right angles. A variable number of immersed corallites occur between the others; in some specimens they are not numerous, in others quite half the corallites are immersed. The length, as well as the prevailing form of the prominent corallites, varies very much in different specimens, even from the same locality. Star little developed, consisting usually of slightly prominent directive septa and four others which are rudimentary. Corallum always porous and reticulate in section near the apex, but frequently dense below; surface spongy-echinulate; wall striate and usually echinulate near the base; the striæ are much more prominent in some specimens than in others.

The majority of the specimens which have come under my notice do not suggest a very close affinity to the arborescent forms *prolifera* and *cervicornis*, and for some time I was inclined to regard them as distinct. Nevertheless a number of intermediate forms occur, chiefly in the collection of the British Museum, which appear to render it necessary to

regard all as varieties of one species; and there appears little reason to doubt that the ultimate form of the corallum, whether flabellate or arborescent, is to a great extent dependent on the environment. Tracing the frondose and vasiform specimens, without branchlets, back to typical *M. prolifera*, the first step is seen in those specimens already referred to in which the course of the branches composing the fronds is indicated by grooves in the surface. In other specimens the branches, though confluent, are well-marked at the apex of the fronds, and an increase in the size of the axial corallites is generally observable in such specimens. Next in the series come two 'Challenger' specimens from St. Thomas, which show the characters of *M. prolifera* so unmistakably that they were referred to that species by Quelch. In one of these the branches form a complanate but not a solid frond; usually from 2 to 5 branchlets are collected together in flattened groups and fused together laterally; they vary from 7 to 12 mm. in thickness, including the radial corallites. Axial corallites 2 to 3 mm. in diameter, with thick and very porous wall. Radial corallites spreading at an angle of about 45° , tubular, with an oblique aperture, or nariform, rather unequal, 1 to 3.5 mm. long, with immersed ones between, especially in the lines of fusion. The other specimen has stouter and less confluent branches, with radial corallites which, in some parts, recall the condition characteristic of *M. cervicornis*.

B. Forma prolifera.

Corallum consisting of much-divided branches which radiate obliquely from a common centre; a typical specimen in the collection of the British Museum is 18 cm. high and 38 cm. broad. Main branches about 20 cm. long and 1.7 cm. thick at the base; subdivisions numerous, chiefly lateral and ascending, the narrow angle between the divisions frequently filled up by sclerenchyma for some distance; middle divisions about 1 cm. thick, distal branchlets 2 to 6 cm. long, 6 to 10 mm. thick, including the corallites; often a dozen or more branchlets form a fan-shaped proliferous group at the distal extremity, 8 cm. long and 9 cm. wide. Axial corallites very variable in size in different parts of the specimen, sometimes 2 mm. diameter, relatively thin-walled, and only 2 mm. exsert, often with oblique aperture, and scarcely differing from the lateral corallites; others have a maximum diameter of 3.5 mm., and are 3 to 5 mm. exsert, sometimes apparently more owing to the extremely small size of the buds on the lower part. Radial corallites usually rather crowded, tubular with oblique aperture, tubo-nariform or nariform, often slightly compressed on the distal parts, usually 4 mm. long and 1.5 mm. diameter, but becoming shorter and stouter, with pore-like aperture, on the basal parts. The under surface of the branches has more distant and irregular corallites, often dilated and appressed. Wall of the corallites on the upper surface rather thin and striato-reticulate at first, becoming thicker and more distinctly echinulate with age. Star usually not prominent, the directive septa are moderately developed, but the remaining members of the primary cycle are more or less rudimentary.

The specimen referred by Ehrenberg to *M. pocillifera*, Lamarck, which M.-Edwards supposed synonymous with his *M. ehrenbergi*, but which is quite distinct from that species,

appears to me to belong here. It consists of only the apical portion of a colony in which the branches are slender and the majority of the radial corallites are tubular. A small specimen of this form in the Berlin Museum bears the name *Porites cristata*, Ehrb., on the label. No species appears, however, to have been described by Ehrenberg under that name.

Other specimens have thicker branches and are more arborescent in habit, and lead up to the forma *cervicornis*.

C. Forma *cervicornis*.

Corallum erect, arborescent, frequently 60 cm. or more in height and 30 to 70 cm. broad. Base sometimes a simple dilatation of the stem, at others broad and incrusting. In certain specimens the whole colony forms an incrustation over dead coral, and only the distal branches are entirely produced by the new colony. In such specimens it frequently happens that the incrustated branches are blunt at the apex, and no axial corallite is distinguishable. At a later period, when independent growth commences, one of the corallites, situated about the centre of the rounded apex, increases gradually in size, and becomes the axial corallite of the branch in its further extension. This accounts to a great extent for the marked variation in size of the axial corallites, and forms an important link between this variety and forma *palmata*. Stem 2 to 4 cm. thick, or, in exceptional cases, 5 cm. Branches elongate and spreading, sometimes almost at right angles, but different specimens vary considerably in this respect; they are round, gradually tapering, 1·3 to 2, rarely 4 cm. thick, usually not much divided, and sometimes simple when 19 cm. in length. Near the periphery of the colony a few short branchlets occur, 1·5 to 3·5 cm. long and about 1 cm. thick; frequently two or three occur close together. Axial corallites cylindrical, normally 4 to 5 mm. thick, and frequently 6 to 8 mm. exsert; wall thick and very porous, strongly striate externally. Primary septa well-developed and subequal, second cycle more or less prominent. It also appears from Agassiz's figures ('Florida Reefs,' pl. xviii.) that in the axial polyp the cycles of large and small tentacles are very distinct, but the difference is not so marked in the radial polyps. Radial corallites rather crowded and more or less appressed near the apex of a branch, but more spreading and usually a little more distant below, from 13 to 16 in 5 cm. Immersed corallites are rare, excepting in the basal parts of the colony. The form is chiefly tubo-nariform in the younger parts and nariform below, where the thickening of the sclerenchyma has covered the tubular base; length 2 to 5 mm., diameter 1·7 to 2·7 mm., but adjoining corallites are subequal, and the longest ones are usually situated near the apex. In some specimens nearly all the radial corallites are nariform, in others a few have a rather elongate lip. Wall firm and a little thickened, but quite porous, becoming much thickened and even keeled with age. The directive septa are broad, the others usually narrow. Corallum porous, surface spongy and echinulate; wall strongly striate and echinulate.

A specimen from Hayti, in the Strassburg Museum, differs from the majority of specimens which have come under my notice in having the whole corallum, including the

surface, dense and finely echinulate, and the wall finely striate. This condition may perhaps be due to secondary deposition of lime.

In the description of this and the preceding variety I have endeavoured to give the leading characters of comparatively typical specimens; but it must be understood that numerous intermediate forms occur which it would be difficult to allocate satisfactorily. The forms described by Ehrenberg as *M. laxa* and *M. regalis* appear to correspond roughly with *M. prolifera* and *M. cervicornis*, Lamk., though in some respects both show intermediate characters. Klunzinger instituted the name *M. superba* for the former, and pointed out that, although Ehrenberg's type is recorded as from the Red Sea, the specimen had attached to it a specimen of *Trochus imbricatus*, Gmel., which is a West-Indian shell, and that therefore the recorded habitat is probably not correct. A specimen in the Berlin Museum, from Hayti, agrees very closely with the type specimen of *M. regalis*. After a careful comparison of the types of Lamarck and Ehrenberg with the fine series of West-Indian and other specimens in the British Museum, I have been unable to recognize any constant characters by which the species may be distinguished from one another. It has therefore seemed advisable to regard all as variations of one species, common to the Atlantic and Indo-Pacific Oceans. Pourtalès has pointed out, with regard to the West-Indian specimens of *palmata*, *cervicornis*, and *prolifera*, that the proper habit and robustness of each form is associated with a different position on the reef. *M. palmata* grows in situations exposed to the force of the sea; *M. cervicornis* in less exposed localities; whilst, for its full development, *M. prolifera* appears to require sheltered spots on the inner side of the reef. The form *M. palmata*, Lamk. (including the various synonyms), is usually readily distinguished from all the others by its habit. Of the arborescent varieties, *M. prolifera*, Lamk., *M. superba*, Klz., *M. regalis*, Ehrb., and *M. cervicornis*, Lamk., form a consecutive series in which the habit gradually becomes more erect, the branches stouter, and the corallites relatively shorter.

The specimens hitherto recorded under the various names included in the synonymy, beginning with Lamarck, nearly all come from the West Indies. The doubtful origin of Ehrenberg's specimens has already been alluded to. Dana's type of *M. alces* is queried from the East Indies, as was also the specimen figured by Rumphius to which he refers. Brüggemann's Rodriguez specimens do not appear to me referable to that species; and the specimen recorded by Ortmann from Panama does not differ materially from alciform specimens of *M. palmata* from the West Indies; added to which Dr. Ortmann informs me that the habitat is not certain. On the other hand, Möbius has recorded the form *M. superba*, Klz., from Mauritius, and Faurot has recently obtained the same variety from the Gulf of Aden. Some of the specimens from Singapore, referred by Ortmann to *M. secunda*, Dana, appear to me to agree closely with West-Indian specimens of *M. cervicornis*, Lmk., and, indeed, are the only specimens I have seen from the Indo-Pacific Ocean in other collections which do so. The most frequent Indo-Pacific variety appears to be *M. superba*, Klz., or *M. regalis*, Ehrb.; but a shallow vasiform specimen of *M. palmata* is in the collection of the British Museum. Several specimens of this species were collected by Mr. Saville-Kent at Thursday Island &c. One specimen is almost identical with a West-Indian specimen of *M. cervicornis* in the British Museum, and a plate-like form with confluent branches also occurs there. Thus the three chief varieties of the species occur both in the Atlantic and Indo-Pacific Oceans; but apparently they are nowhere so abundant as in the West Indies.

West Indies and Indo-Pacific Ocean (Red Sea to Tahiti).

A. Forma *palmata*.

<i>a, b.</i> Florida.	Sir W. Thomson [C.]. 91. 2. 3. 1 & 6. [404.
<i>c-f.</i> St. Thomas.	H.M.S. 'Challenger.' 86. 12. 9. 278, 275, 276, &
<i>g.</i> St. Thomas.	H.M.S. 'Challenger.' 80. 11. 25. 16.
<i>h.</i> St. Thomas.	H.M.S. 'Challenger.' 86. 11. 25. 16.
<i>i.</i> Pedro and Morant Cays, Caribbean Sea.	Lieut. Carpenter [P.]. 82. 1. 17. 11.
<i>j.</i> Caribbean Sea.	Mrs. Anlaby [P.]. 66. 11. 24. 1.
<i>k.</i> —?	J. Smith, Esq. [P.]. 57. 12. 16. 7.
<i>l.</i> —?	—? 37. 6. 10. 292.
<i>m.</i> —?	Purchased. 55. 12. 27. 93.
<i>n-ee.</i> —?	—? 93. 4. 7. 1 to 18.
<i>ff.</i> Jamaica.	Purchased. 74. 6. 5. 1. (<i>M. alces</i> , Dana.)
<i>gg-jj.</i> —?	—? 93. 4. 7. 19 to 21, & 84. (<i>M. alces</i> , Dana.)
<i>kk.</i> Port Darwin.	Saville-Kent Coll. 92. 6. 8. 213.
<i>ll.</i> Singapore.	—? 93. 4. 7. 24.

Forms intermediate between *prolifera* and *palmata*.

<i>a, b.</i> St. Thomas.	H.M.S. 'Challenger.' 86. 12. 9. 277 & 405.
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Forms intermediate between *cervicornis* and *palmata*.

<i>a.</i> St. Thomas.	H.M.S. 'Challenger.' 86. 12. 9. 274.
<i>b, c.</i> —?	—? 93. 4. 7. 22 & 23.
? <i>d.</i> —?	—? 93. 4. 7. 85.

B. Forma *prolifera*.

<i>a.</i> Barbadoes.	G. F. Franks, Esq. [P.]. 91. 1. 20. 3.
<i>b.</i> Caribbean Sea.	Purchased. 85. 1. 21. 1.
<i>c.</i> —?	Purchased. 43. 2. 10. 72.
<i>d.</i> —?	Purchased. ? 55. 12. 27. 17.
<i>e-u.</i> —?	—? 93. 4. 7. 42 to 58.
<i>v.</i> Wreck Bay, Great-Barrier Reef, N.E. Australia.	Jukes Coll. 46. 7. 30. 8.
<i>w.</i> —?	Purchased. 53. 4. 8. 19.
<i>x, y.</i> St. Vincent, West Indies.	Dr. Guilding Coll. 39. 12. 26. 41 & 42.
<i>z.</i> St. Thomas.	H.M.S. 'Challenger.' 86. 11. 25. 17.

Forms intermediate between *prolifera* and *cervicornis*.

<i>a.</i> ? Florida.	Sir W. Thomson [C.]. 91. 2. 3. 8.
<i>b.</i> West Indies.	Purchased. 43. 2. 10. 19.
<i>c.</i> Tahiti.	—? 93. 4. 7. 43. (<i>M. regalis</i> , Ehrb.)

C. Forma *cervicornis*.

<i>a.</i> St. Thomas.	H.M.S. 'Challenger.' 86. 12. 9. 282.
<i>b.</i> St. Thomas.	H.M.S. 'Challenger.' 80. 11. 25. 17.
<i>c, d.</i> Barbadoes.	G. F. Franks, Esq. [P.]. 91. 1. 20. 1 & 2.
<i>e, f.</i> ? Florida.	Sir W. Thomson [C.]. 91. 2. 3. 2 & 7.

<i>g.</i> St. Kitt's.	——? 93. 4. 7. 25.
<i>h.</i> ——?	Mr. Sowerby [P.]. 45. 5. 21. 136.
<i>i.</i> ——?	——? 37. 6. 10. 12.
<i>j-y.</i> ——?	——? 93. 4. 7. 26 to 41.
<i>z-bb.</i> Port Darwin.	Saville-Kent Coll. 92. 6. 8. 210 to 212.
<i>cc.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 214.

2. *Madrepora secunda*.

Madrepora secunda, Dana, Zoophytes, p. 481, pl. 40. fig. 4; M.-Edwards & Haime, Coralliaires, t. iii. p. 138; Verrill, Append. to 1875 ed. Dana's Corals & Coral Islands, p. 333; Studer, Mitth. naturf. Ges. Bern, 1880, p. 18; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 17 (under *M. nobilis*); Ortmann, Zool. JB. 1888, Bd. iii. p. 150 (part.); ibid. 1889, Bd. iv. p. 504; ? Bassett-Smith, Ann. Mag. Nat. Hist. 1890, vol. vi. p. 452.

Madrepora nobilis (part.), Verrill, Bull. Mus. Comp. Zool. vol. i. 1864, p. 40, and later papers; (*non* Quelch, 'Challenger' Reef Corals, p. 150).

Corallum arborescent; branches numerous, terete, 12 to 17 mm. thick, summit branchlets 8 mm. thick, gradually tapering. Corallum scabrous; axial corallite 2 mm. broad. Radial corallites rather crowded, equal, nariform or dimidiate, and very much compressed, hardly stout, 2 to 3 mm. long; obsolescent on the inferior side of the branches. Star distinct, the directive septa quite prominent. Height of the corallum 46 cm. or more. (*Dana.*)

A specimen in the Saville-Kent Collection agrees well with Dana's description and figure, and is quite distinct from *M. cervicornis*. The branches are 1.7 cm. diameter, laxly coalescent. Axial corallites 3 mm. diameter, little exsert; some of the radial corallites which form new outgrowths have the same diameter, and may be 1 cm. long and bear only a few bud-corallites. At a later stage these form branchlets 2.5 cm. long, and sometimes only 3.2 mm. diameter near the base, provided with numerous bud-corallites excepting near the apex. Radial corallites rather distant, as figured by Dana, not crowded, as noted in his description, thin-walled, tubo-nariform or dimidiate, 3 to 4.5 mm. long and 1.2 to 1.6 mm. diameter; those near the apex much compressed, with smaller ones between. Star scarcely developed; two narrow directive septa are usually present, and sometimes indications of others. Corallum porous; surface spongy-echinulate; wall striato-reticulate, not echinulate unless near the base.

Indo-Pacific Ocean: Singapore, Ceylon, ? China Sea, Great-Barrier Reef.

<i>a.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 76.
? <i>b.</i> Tizard Bank, 5 fathoms.	H.M.S. 'Rambler.' 89. 9. 24. 104.
<i>c.</i> Baudin Is., N.W. Australia:	H.M.S. 'Penguin.' 92. 1. 16. 6 (part).

3. *Madrepora crassa*.

Madrepora crassa, M.-Edwards & Haime, Coralliaires, t. iii. p. 135 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 149).

Corallum stout, arborescent, each branch giving rise to a cluster of little-spreading branchlets, more proliferous near the apex and with occasional fusions from one branch to

another. Diameter of main branches 2·8 to 3·3 cm., length about 35 cm. Penultimate divisions nearly 2 cm. diameter, about 4 cm. long, and with a crown of buds at the apex. Axial corallites nearly 4 mm. diameter and 4 mm. exsert; sometimes 4·5 mm. diameter, with only 1 mm. aperture and a very thick porous wall. Radial corallites large, appressed, half tubular, up to 6 mm. long and 3 mm. broad, but a little irregular both in size and disposition. There are no truly immersed corallites, except in the lines of fusion. Directive septa long, the others shorter, with or without a rudimentary second series. Corallum stony, but a little porous; surface spongy-echinulate; wall strongly ribbed, becoming echinulate below.

The above description is based on a specimen in the Paris Museum, from the Galapagos Islands. Another specimen, also forming part of the collection of M.-Edwards, but without habitat, differs in having smaller radial corallites, 3 mm. long and 2 mm. diameter; the apex of this specimen is not preserved, so that one cannot decide if the axial corallites were of the same size as in the type.

Galapagos Islands.

4. *Madrepora intermedia*. (Pl. I. fig. C.)

Madrepora intermedia, Brook, Ann. Mag. Nat. Hist. 1891, vol. viii. p. 463.

Corallum arborescent, similar to that of *M. secunda* in habit. Main branches 2 to 2·5 cm. thick and 25 cm. long, moderately subdivided, especially near the apex. Ultimate divisions 3 to 6 cm. long and 1 cm. or more thick, gradually tapering to a blunt apex, or more rapidly tapering and pointed. Axial corallites 2·5 mm. diameter, 0·5 to 2 mm. exsert, but usually short; aperture large, frequently oval; primary septa well developed, second series not prominent. Radial corallites tubular, spreading, very variable in length and also in diameter. The majority extend almost at right angles to the branch, excepting near the apex, and have a more or less oblique aperture; they are about 3 mm. long and 2 mm. diameter; wall firm, but not thickened. Numerous short tubular to subimmersed corallites occur between the others, varying from 1 to 1·5 mm. in diameter. The corallites become short and thickened wart-like on the main branches, whilst on the under surface the majority are immersed. Primary septa narrow, but the directives are moderately prominent, and in the older parts of the corallum may be broad. Corallum very porous, surface reticulate and echinulate; wall striato-echinulate, becoming later echinulate in linear series. One specimen resembles *M. muricata* f. *palmata* in habit, and consists of a thick solid frond with incipient branches on the upper surface and numerous short ones at the periphery.

This species differs from *M. secunda* in the form and markedly unequal size of the corallites. From *M. muricata* f. *cervicornis* it differs in the form and angle of the corallites, the density of the corallum, and also in the presence of numerous immersed corallites, particularly on the under surface of the larger branches.

Indian Ocean: Maldiv Islands.

a, b. Maldiv Islands.

Purchased. 86. 11. 22. 6 & 10. (Types.)

c. Maldiv Islands.

Purchased. 86. 11. 22. 11. (Var.)

**** Branches rarely over 1 cm. thick.**

5. *Madrepora gracilis*.

Madrepora gracilis, Dana, Zoophytes, p. 482, pl. xli. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 147; Quelch, 'Challenger' Reef Corals, p. 158 (part.); Duncan, Journ. Linn. Soc. Lond. 1886, vol. xxi. p. 19; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16 (*non* Ortmann, Zool. JB. 1889, Bd. iv. p. 503).

? *Madrepora pustulosa*, Quelch (*non* M.-Ed. & H.), 'Challenger' Reef Corals, p. 158.

Corallum arborescent, spreading ramose; branches slender, 6 to 10 mm. thick, arcuate, gradually attenuate. Axial corallites 2 cm. long and broad; radial corallites equal, rather crowded, stout compressed nariform, small (2 mm. long), aperture narrow, star distinct, the directive septa broadest. The radial corallites become quite short at a distance of 10 cm. from the apex. Surface of the cœnenchyma appears smooth, wall finely striate. (*Dana*.)

The following are some of the more important details of the Challenger specimens:—Axial corallites 2 mm. diameter, very little prominent, aperture large; septa in two well-developed cycles, the directives broadest. Radial corallites mostly 4 mm. long and 1 mm. diameter, compressed tubo-nariform, or tubular with very oblique aperture; a few much smaller and shorter ones scattered between the others. Corallum very porous in section, surface spongy-echinulate, wall costate, costæ spinose, particularly near the base.

Indo-Pacific Ocean: Ceylon to Sulu Sea and Fiji.

a-b. Amboina. H.M.S. 'Challenger.' 86. 12. 9. 270 & 272.

? *c*. Levaku, Fiji. H.M.S. 'Challenger.' 86. 12. 9. 239. (= *M. pustulosa*, Quelch.)

6. *Madrepora heteroclados*.

Madrepora cf. ramiculosa, Ortmann, Zool. JB. 1888, Bd. iii. p. 153.

Corallum shrubby arborescent, with erect little-spreading subdivisions or with divaricate and curved branchlets; sometimes both forms occur in the same specimen. Branches up to 10 cm. long and 1 cm. thick at the base; divisions spiciform, erect or spreading obliquely with arched spiciform branchlets, 3.5 cm. long; marginal twigs about 5 mm. thick at a point 2 cm. from the apex. Axial corallites 1.5 to 2 mm. diameter, 1 mm. exsert; wall thickened, margin slightly rounded. Radial corallites spreading blunt-nariform, with convex lower and horizontal upper margin, or spreading tubular with an oblique aperture; a smaller number are gutter-shaped. Length 2 mm., diameter 1.2 to 1.5 mm., wall thin but firm. Nearer the base of the branchlets many of the corallites are hooked-nariform with a thicker wall, others are hemicotyloid to subimmersed. Star not prominent, but the directive septa may be broad. Corallum rather dense; surface dense and tabulato-echinulate; wall finely striato-echinulate. In the divaricately-branched forms the subdivisions sometimes become fused together.

Pacific Ocean: Pelew Islands, Ponapé, Tahiti. (*Strassburg Museum*.)

7. *Madrepora attenuata*. (Pl. XXXV. figs. C, D.)

Corallum slender, arborescent, 24 cm. or more in height. Main branches or stems (?) 1.2 cm. thick, gradually attenuate, giving rise to numerous branches and branchlets at an angle of 30° to 40° , but occasionally the angle is wider; the branches are usually simple, 1.5 to 11 cm. long, the longer ones being 5 to 7 mm. thick and slowly tapering. Axial corallites 2 mm. diameter, 1 to 2.5 mm. exsert, wall porous and a little thickened, strongly striate, the striae echinulate; star well developed, the primary septa subequal and often nearly meeting together in the middle line, the second cycle also well developed. Radial corallites spreading and distant, usually 2 mm. apart, nariform, often with a hooked lip, labellate or tubular with an oblique aperture, varying in length from 2 to 4 mm., diameter 1.5 mm., little variable; the wall is moderately thick and very firm, becoming shorter and more verruciform below. A few longer tubular corallites with round aperture occur near the apex of the branches, some of which bear buds and indicate the position of new branchlets. Star not very distinct, the directive septa are well developed, but the remaining primaries and those of the second cycle are usually narrow. Corallum rather porous near the apex, rapidly becoming denser below, surface dense, closely clothed with fine echinulations throughout; wall substriate or echinulate in longitudinal rows.

West Indies.

a-j. West Indies. Purchased. 43. 2. 10. 70 to 74 & 93. 4. 7. 142 to 146. (Types.)

b. *Colony massive, with irregular or mammiform elevations in place of proper branches.*

8. *Madrepora cyclopea*.

Madrepora cyclopea, Dana, Zoophytes, p. 439; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15.

Madrepora cycloptera, M.-Edwards & Haime, Coralliaires, t. iii. p. 161.

Dana's description, taken from worn specimens, is as follows:—"Very broad foliate and ponderous, fronds spreading, lobed, 3 to 6 inches thick and 6 feet or more broad, with large rounded, remotely scattered knobs, 2 to 3 inches thick. Corallum above having calicles crowded." The species is not figured and has not been recorded by subsequent investigators.

The following description is taken from two specimens in the British Museum, which appear to be referable to this species:—Corallum consisting of extremely massive, digitate fronds about 1.8 m. across. Digitiform lobes rounded and gradually tapering to a relatively slender apex; they are sub-reniform in section about the middle of a lobe; diameters at a point about 40 cm. from the apex, 14 by 10 cm. The superior surface is covered with irregular tubercles, those on the lobes becoming arranged chiefly in two series, one near each lateral border; they are 2 to 5 cm. broad and about as high as broad, occasionally conical, with a prominent central corallite, which, however, does not differ in size or thickness from the others. Prominent corallites crowded, tubular, with a firm and moderately thick wall; aperture usually round, rarely oblique. Length 1 to 6 mm., diameter 1.5 to 2.5 mm.; average about 2 mm. diameter and 4.5 mm. long. Scattered between the

prominent corallites a variable number of immersed ones occur, some about 1 mm. diameter, but the majority much smaller, often under 0.5 mm. The prominent corallites become shorter and more distant on the under surface, where many are subimmersed, but the small-sized immersed corallites appear wanting. Corallum very dense and stony, surface granulate-echinulate; wall striate above, the costæ becoming divided into dentate plates below. The prominent corallites usually possess 12 septa, all of which are narrow, sometimes only the directives are prominent; the smaller immersed corallites have only 6 septa.

The species is at once recognized by the extremely massive corallum without proper branches, but the form of the corallites is similar to that of some varieties of *M. muricata*.

West Indies, ? Indian Ocean.

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|--------------------|--------------------------------------|
| <i>a.</i> Bahamas. | Colonial Exhibition. 86. 10. 13. 10. |
| <i>b.</i> — ? | — ? 93. 4. 7. 80. |

9. *Madrepora conigera*.

Madrepora conigera, Dana, Zoophytes, p. 440, pl. xxxii. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 159; Studer, Mitth. naturf. Ges. Bern, 1880, p. 22; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 14; Ortmann, Zool. JB. 1889, Bd. iv. p. 503.

Corallum consisting of massive horizontal (?) plates 2.5 to 6 cm. thick, lobed at the margin, and sometimes deeply subdigitate; above covered with short and stout subacute cones; surface plain below. The cones on the upper surface are irregular in size and height, and the narrow intervals between are occupied chiefly by immersed corallites. The cones are 1.2 to 3 cm. in diameter, and 1 to 3 cm. high: some are rather flat above, without any marked axial corallite; others are more distinctly pointed, with tubular axial corallites 2 to 3 mm. in diameter and 2 to 3 mm. exsert; wall dense, not very thick, and strongly costulate. Radial corallites erect, labellate or tubular, with a more or less oblique aperture, variable in length (2 to 4 mm.), and 1.5 to 2 mm. diameter. A few immersed and short nariform corallites are scattered amongst the others. The lower part of each cone is occupied by elongate oblique tubular corallites, some of which bear 1 to 3 labellate bud-corallites. Primary septa all very narrow, with the outer directive sometimes most marked. Corallites on the flat under surface all very short or immersed, the longest are tubo-nariform. Cœnenchyma very dense, and the surface reticulate with rounded knobs in place of the usual pointed echinulations; corallite-wall firm and dense, striato-echinulate.

Singapore.

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|-----------------|-------------------|
| <i>a.</i> — ? | — ? 93. 4. 7. 70. |
| ? <i>b.</i> — ? | — ? 93. 4. 7. 71. |

10. *Madrepora smithi*. (Pl. XXVI. fig. B.)

Madrepora pyramidalis, Bassett-Smith (*non* Klunzinger), Ann. Mag. N. H. 1890, vol. vi. p. 453 (part.).

Madrepora seriata, Bassett-Smith (*non* Ehrenberg), loc. cit. p. 453.

Madrepora paxilligera, Bassett-Smith (*non* Dana), loc. cit. p. 453.

Corallum massive, incrusting, forming broad arched plates with broad pyramidal or conical elevations on the upper surface, and clustered ascending twigs towards the margin. The cones are very unequal in size, 2.5 to 6.5 cm. in diameter at the base and 2 to 3.5 cm. high. The axial corallites of the cones are only 2 to 2.5 mm. diameter, and scarcely exsert. Short proliferous tubular corallites, not over 5 mm. long, are scattered irregularly over the surface of the larger cones; the radial corallites between them are short, tubular, with a more or less oblique aperture, outer part of the wall thickened, the inner thin; length 2 mm. or rather more, diameter slightly under 2 mm. Such tubular corallites are about 3 to 5 mm. apart, the interval between them is occupied by short nariform, subimmersed and small immersed corallites. The star of the prominent corallites consists of well-developed directive septa which nearly meet in the middle line, and of four other primaries together with part of a second cycle, all of which are narrow and subequal, but the primary septa are stouter. The marginal branches are 4 to 6 cm. long and about 6 to 12 mm. thick; the stouter ones are distinctly tapering. On these the axial corallites are hemispherical, 3 to 3.5 mm. diameter, with a well-developed star of 12 septa. The radial corallites are chiefly gutter-shaped, but with a variable number of short or immersed ones between; length 2 to 3 mm., diameter 2 mm. at the apex, margin not rounded. The directive septa are prominent, the remaining primaries narrow, and a second cycle is not developed. The form of the radial corallites of the marginal branches resembles that of *M. nobilis*.

China Sea.

<i>a, b.</i> Tizard Bank, 2 fath.	H.M.S. 'Rambler.'	89. 9. 24. 100 & 159. (= <i>M. pyramidalis</i> , B.-Sm.)	} Types of the species.
<i>c.</i> Tizard Bank, 2 fath.	H.M.S. 'Rambler.'	89. 9. 24. 98. (= <i>M. seriata</i> , B.-Sm.)	
<i>d.</i> Tizard Bank, 1 fath.	H.M.S. 'Rambler.'	89. 9. 24. 112. (= <i>M. pavilligera</i> , B.-Sm.)	
<i>e.</i> — ?	— ?	93. 4. 7. 87. (Specimen figured.)	

B. Corallum consisting of horizontal or oblique radiating branches which ultimately become fused into a disk-shaped plate or shallow vase, with numerous proliferous corallites on the upper surface.

11. *Madrepora efflorescens*.

Madrepora efflorescens, Dana, Zoophytes, p. 441, pl. xxxiii. fig. 6; M.-Edwards & Haime, Coralliaires, t. iii. p. 159 (non Ortmann, Zool. JB. 1888, Bd. iii. p. 153; *ibid.* 1889, Bd. iv. p. 511; non B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454).

Corallum vasiform?, branches coalescing into a solid plate 12 to 18 mm. thick, reticulate only at the margin and ribbed with the coalescing branches. Corallum flat below, and having very short crowded branchlets above; the marginal ones 12 mm. long and 3 mm. diameter; those near the middle of the colony not terete, 6 mm. long, acervate and proliferous. Corallites on the under surface short; on the upper surface the branchlets bear labellate corallites with long erect lip. Apical corallites cylindrical, 2 mm. long and 1 mm. broad. (*Dana.*)

There are several specimens in the collection of the British Museum which appear referable to this species, but unfortunately the habitat is not recorded of any of them. One fine specimen forms a broad shallow vase 55 cm. wide and 16 cm. high, from an oval base 12 by 6 cm. across, with an extra central lobe not in the interior of the vase. The corallum, in spite of its large size, is only 2 to 2.5 cm. thick, and is quite solid without any indication of branches below, excepting near the margin. Corallites on the under surface very crowded and spreading tubular, 1.5 to 2.5 mm. diameter and 2.5 to 4.5 mm. long. They are longest near the base and have the wall a little thickened, strongly echinulate but not striate; they are usually so crowded that scarcely any cœnenchyma occurs between, and sometimes the walls are partly confluent; at the margin of the corallum they are strongly appressed. The star consists of 6 moderately developed septa. There are no immersed corallites on the under surface of this specimen (which is not at all worn), even those in the lines of fusion of the branches have a ring-shaped border. The main branches are not recognizable from the upper surface, excepting in the marginal 8 to 10 cm. of the colony (where they are 8 mm. thick), but their course is clearly indicated by radiating rows of proliferous corallites separated by rows of immersed or subimmersed ones. The branchlets on the upper surface would be more correctly described as erect clusters of proliferous corallites, none of which exceed 1.3 cm. in length, the majority are much shorter. They occur in great numbers along the upper surface of the branches, and may consist of a single elongate tubular corallite bearing appressed labellate ones at the base, or of a cluster of 3 or 4 such proliferous corallites, or of larger groups 1 to 1.5 cm. in diameter. Axial corallites cylindrical, 2 mm. broad, and usually 3 mm. exsert. Radial corallites chiefly labellate or tubo-labellate, with a very elongate aperture 4 mm. long and 1.5 to 2 mm. wide at the apex, but usually narrower below, wall strongly striate. Those corallites which are proliferous become tubular and a little compressed, 6 mm. long and 2 mm. diameter. Between the proliferous clusters, shorter labellate or immersed corallites occur, and immersed or subimmersed corallites occupy the intervals between the rows of proliferations. In the corallites of the upper surface the star is very imperfectly developed. Corallum porous and reticulate in section, surface spongy and echinulate. Wall of the corallites of the upper surface distinctly striate, echinulate at the base. The branches of the inner lobe of the vase are free at the extremities.

Two other specimens agree in most points with the one already described, but are worn and all the corallites on the under surface are immersed, but this may be due to injury. A fourth specimen appears to represent an early condition of the species before the main branches become fused into a solid plate. It consists of several curved fan-like lobes, the branches of which are confluent only near the base. The free portions of the branches bear a close resemblance to those of *M. palmata* forma *prolifera* under similar circumstances, but differ in having proliferous corallites on their upper surface and short, rather stout tubular ones below.

Singapore; East Indies (*Dana*).

<i>a.</i> —?	Purchased. 73. 1. 20. 1.
<i>b, c.</i> —?	—? 93. 4. 7. 66 & 67.
<i>d.</i> —?	—? 93. 4. 7. 64.
<i>e.</i> —?	Purchased. 44. 6. 10. 15. (Young colony.)
<i>f.</i> —?	—? 93. 4. 7. 65.
<i>g.</i> —?	—? 93. 4. 7. 132.

12. *Madrepora vasiformis*. (Plate XXVI. fig. A.)

Madrepora flabelliformis, Brüggemann (*non* M.-Edwards & Haime), Phil. Trans. 1879, vol. clxviii. p. 575.

Corallum shallow, solid, vasiform, 28 cm. diameter, 10 cm. high; attachment oblique. The under surface is quite solid, excepting towards the margin of the colony, where the outline of the branches is indicated by narrow fissures. The whole under surface is devoid of branchlets, and is covered with crowded suberect tubular corallites; some are sub-immersed, with rather thin wall, but the majority have the wall thick and the margin rounded, many have the wall much dilated; length 1 to 3 mm., diameter 1 to 3 mm., according to the thickness of the wall; the directive septa are often the only ones recognizable, but in other cases the primary series may be more or less complete. The upper surface of the vase consists of numerous short subconical twigs, which arise obliquely from the main branches; their apices are about 1.5 cm. apart, length 1.5 to 3 cm., diameter at the base 8 to 12 mm., those near the margin of the vase are closely applied to the main divisions. Axial corallites cylindrical, 2 to 2.5 mm. diameter; the primary septa almost meet in the middle line, but the directives are slightly broader; a second cycle is not recognizable. Radial corallites crowded, spreading, very unequal, and of variable form; the largest are thick-walled, tubular, with the inner part of the wall often incomplete, margin slightly rounded, wall porous; such corallites may bear one or two very small buds on the outer surface; length 3 mm., diameter 1.8 mm.; others between are nariform, dimidiate, or labellate, with the wall of variable thickness, many towards the base are subimmersed. In the tubular corallites the star consists of 6 septa, the directives, and especially the outer one, most prominent. All the septa are very narrow in the subimmersed corallites, often only the directives are recognizable. Corallum moderately porous, wall striato-echinulate.

In habit the species closely resembles *M. efflorescens*, but the absence of a second cycle of septa in the axial corallites renders it uncertain whether it really belongs to the same subgenus.

Rodriguez.

a. Rodriguez. Royal Society [P.]. 76. 5. 5. 92. (Type = *M. flabelliformis*, Brügg.)

13. *Madrepora orbicularis*. (Plate II.)

Madrepora efflorescens, Ortmann (*non* Dana), Zool. JB. 1889, Bd. iv. p. 511; ? *ibid.* 1888, Bd. iii. p. 153.

Madrepora orbicularis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 460.

Corallum disk-shaped, 50 cm. broad and 4.5 cm. thick near the margin, thicker in the central part, with numerous irregular prominences. On the under surface the branches are fused into an almost solid plate, almost plane in some parts, but in others with irregular

appressed branchlets about 1 cm. thick and from 1 to 2.5 cm. long; surface spongy, with scattered immersed corallites and a variable number of dilated appressed tubular ones about 3 mm. thick, narrowed towards the apex; star of 12 well-developed septa, wall striato-echinulate. On the upper surface all but the central portion consists of several layers of radiating subhorizontal branches laid one over the other like rows of tiles, the lower layer longest, and the others gradually diminishing in length, the whole fused into a solid mass with often only the distal parts of the branches distinct; diameter of the branches 8 to 20 mm. Axial corallites cylindrical, variable in size, 2.5 to 4 mm. diameter, and 2 mm. exsert, wall thick and porous, strongly striate, aperture 0.75 mm. The branches bear numerous prominent corallites, 2.5 to 6 mm. long, and 1.5 to 2 mm. thick, the larger of which are proliferous, but the buds which they bear are always small and delicate labellate. The prominent corallites are dimidiate and a little appressed near the apex of a branch, but in other situations generally spread almost at right angles. Those which become proliferous are 2 to 3 mm. apart, and in them the inner part of the wall gradually increases in length, at the same time the wall is thickened, and they then resemble the smaller axial corallites in form. Between are small labellate corallites with a narrow lip and numerous small immersed ones. Star well developed in nearly all the prominent corallites, the directive septa very broad. In the very numerous and small immersed or narrow-lipped corallites the directive septa are often confluent, but the other primary septa are relatively narrow. Corallum very porous, surface spongy-reticulate, wall striato-reticulate and echinulate.

The species resembles *M. efflorescens* in general habit, but differs altogether in its disk-shaped corallum, composed of several rows of branches instead of a single row, in the scattered instead of clustered proliferous corallites, in the stouter axial corallites, the much smaller bud-corallites of the proliferations, the condition of the under surface, and in other points.

Indian Ocean: Ceylon.

a. Ceylon.

b, c. Ceylon.

Dr. Ondaatje [P.]. 83. 3. 24. 7. (Type.)

Haeckel Coll. 92. 12. 5. 25 & 26.

C. Prominent radial corallites ascending tubular.

14. *Madrepora acuminata*.

Madrepora acuminata, Verrill, Bull. Mus. Comp. Zool. vol. i. 1864, p. 40.

The following is Verrill's description:—

"A large species allied to *M. nobilis*, but having much longer, regularly-tapering, often curved branches, 1 inch in diameter, evenly rounded, and thickly covered by spreading, nearly uniform, cylindrical, dimidiate corallites. Surface of the corallum between the cells and exterior to corallites covered with minute spines, the latter subcostate. Septa rudimentary, only the two largest usually distinct. A few rudimentary corallites, often opening downwards, are scattered among the others."

A specimen in the collection of the British Museum, which I doubtfully refer to this species, differs from typical *M. nobilis* and *M. pacifica* in habit, but agrees closely with the above description. It is erect arborescent, about 35 cm. high, laxly branched, the branches about 2.5 cm. diameter near the base, and up to 25 cm. long, with crowded corallites on the superior surface, and thicker appressed, more distant, and very irregular ones below. Axial corallites 3 mm. diameter and 2 mm. or more exsert, with a large, often oval, aperture, and 12 well-developed septa. The tubular corallites are about 1.5 mm. diameter, usually compressed, and 2.5 to 5 mm. long. Corallum very firm, but moderately porous, surface spongy-echinulate; wall subcostulate, strongly echinulate near the base. The corallites are more irregularly crowded and not so spreading as those of *M. pacifica*, the wall is echinulate and the corallum more porous. The directive septa are thick and moderately broad; the others thin and narrow, often quite rudimentary.

Pacific Ocean : Kingsmill Islands.

a. — ?

— ? 93. 4. 7. 81.

15. *Madrepora pacifica*. (Plate XXX. fig. B.)

Madrepora robusta, B.-Smith (*non* Dana), Ann. Mag. N. H. 1890, vol. vi. p. 452.

Madrepora pacifica, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 465.

Corallum subarborescent, stout, spreading obliquely, resembling that of *M. nobilis* in habit. Branchlets 6 to 15 cm. long and 2 to 3 cm. thick, simple or subsimple, tapering slightly to a blunt apex, or the distal half more rapidly tapering and pointed. Axial corallites 2.5 mm. diameter or a little over, 2 mm. exsert. Radial corallites much crowded, about half are elongate, tubular, half-tubular, or dimidiate, the remainder short, labellate, sub-immersed or immersed. The prominent corallites are about 1.5 mm. in diameter and 3 to 4 mm. long, spreading nearly at right angles, often a little recurved; wall firm, but relatively thin, delicately striate, without echinulations. Primary cycle of septa not prominent, the directives most noticeable; in many of the immersed corallites they alone can be made out. Corallum very dense, surface spongy-echinulate; in many parts the corallites are so crowded that little or no cœnenchyma occurs between them.

The species differs from *M. nobilis* in the more crowded and more elongate corallites, without the thickened wall which occurs in the larger corallites of that species; also in the more rudimentary septa and the denser corallum.

A specimen referred by Mr. Bassett-Smith to *M. robusta* appears to belong to this species, but the branches are not so stout as in the type, and the corallum appears to form an incrustation over dead pieces of coral.

Pacific Ocean : Samoa Islands, China Sea.

a. Samoa Islands.

Rev. S. J. Whitmee [P.]. 75. 10. 2. 13. (Type.)

b. Tizard Bank, 5 fath.

H.M.S. 'Rambler.' 89. 9. 24. 107. (= *M. robusta*, B.-Smith.)

16. *Madrepora arbuscula*.

Madrepora arbuscula, Dana, Zoophytes, p. 474, pl. xl. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 138; Verrill, Proc. Essex Inst. 1866, vol. v. p. 21; ? ibid. 1869, vol. vi. p. 69; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Studer, Mitth. naturf. Ges. Bern, 1880, p. 19; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 12; Ortmann, Zool. JB. 1888, Bd. iii. p. 149.
 ? *Madrepora scabrosa*, ? B.-Smith (*non* Quelch), Ann. Mag. N. H. 1890, vol. vi. p. 452.

Corallum arborescent, much branched, forming bushy clumps 30 cm. high and 40 cm. in diameter from a stem 2 cm. thick. Branches spreading, terete, 8 to 18 mm. diameter, only slightly tapering. Upper branches often 8 to 11 cm. long, simple and very gradually attenuate. Axial corallites 2.5 to 3 mm. diameter and 2.5 mm. exsert, wall thick and porous. Radial corallites 1.5 mm. diameter and 3 to 4 mm. long, tubular, more or less ascending, and with a moderately thick wall; crowded on the superior surface, but more distant on the underside, becoming short and thick tubercles on the under surface of the stouter branches. Corallum porous and fenestrated in section, surface finely reticulate and echinulate; wall striato-reticulate when thin, becoming evenly echinulate with increase in thickness. All the primary septa are broad, the directives nearly meet in the middle line; second cycle inconspicuous.

Indo-Pacific Ocean: Singapore, Sulu Sea, ? Japan, Great-Barrier Reef.

- | | |
|------------------------------|--|
| <i>a.</i> — ? | Mr. Sowerby [P.]. 45. 5. 21. 135. |
| <i>b.</i> — ? | Purchased. 59. 12. 12. 1. |
| <i>c.</i> — ? | — ? 93. 4. 7. 86. |
| <i>d, e.</i> Palm Island. | Saville-Kent Coll. 92. 6. 8. 73 & 74. |
| <i>f.</i> Channel Rock Reef. | Saville-Kent Coll. 92. 6. 8. 79. |
| ? <i>g.</i> Tizard Bank. | H.M.S. 'Rambler.' 89. 9. 24. 110. (= <i>M. scabrosa</i> ?, B.-Sm.) |

17. *Madrepora virgata*.

Madrepora virgata, Dana, Zoophytes, p. 471, pl. xxxix. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 145; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Studer, MB. Akad. Wiss. Berlin, 1878, p. 533; Quelch, 'Challenger' Reef Corals, p. 158; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

Madrepora gracilis, Quelch, 'Challenger' Reef Corals, p. 158 (part.).

Corallum slender, arborescent, spreading and remotely ramose; branches under 1 cm. in diameter, very long, terete, subarcuate, not proliferous. Cœnenchyma scarcely porous, minutely granulous; radial corallites small, rather crowded, very short and thin tubular; margin acute, cell circular, star of six narrow rays. Terminal branches often 15 cm. long, very gradually tapering.

The above is a summary of Dana's description: the 'Challenger' specimens referred by Quelch to this species differ in several important points. The cœnenchyma is very porous and reticulate in section, the surface is covered with closely-placed rows of dentate

plates; wall costulate, the costae divided into dentate plates below. Axial corallites prominent, ?2.5 mm. diameter; radial corallites short, tubular, mostly 1.5 to 1.7 mm. long and 1 mm. diameter, with a thin wall and circular aperture; a few smaller ones are scattered amongst the others, but none are immersed; most are placed at an angle of about 45°, and are therefore not so spreading as in *M. formosa*, Dana. One of the fragments from Amboina, referred by Quelch to *M. gracilis*, appears to me to belong here. Some of the specimens from Tahiti and Tongatabu are bushy, with proliferous twigs near the apex.

Pacific Ocean: New Hanover, Fiji, Tahiti, Amboina, Tongatabu.

a. Tahiti.	H.M.S. 'Challenger.'	86. 12. 9. 236.	
b. Tahiti.	H.M.S. 'Challenger.'	86. 12. 9. 237.	
c-e. Papeete Reefs, Tahiti.	H.M.S. 'Challenger.'	80. 11. 25. 235.	
		86. 12. 9. 406.	
		91. 9. 9. 2.	
f. Amboina.	H.M.S. 'Challenger.'	86. 12. 9. 229.	(= <i>M. gracilis</i> , Quelch, part.)
g,h. Tahiti.	—?	93. 4. 7. 74 & 76.	
i,j. Tahiti?	—?	93. 4. 7. 75 & 77.	
k. Tongatabu.	J. J. Lister, Esq. [P.].	91. 3. 6. 4.	

D. *Prominent corallites short, erect, tubular, unless near the apex of a branch.*

a. *Branches 2 cm. thick or more.*

18. *Madrepora tylostoma*.

Heteropora tylostoma, Ehrenberg, Corallenth. d. roth. Meeres, p. 111.

Madrepora tylostoma, Dana, Zoophytes, p. 489.

The type specimens are much worn, and belong to a stout and laxly-arborescent species resembling *M. secunda* or *M. muricata* var. *cervicornis* in habit. Stoutest branches 2.5 cm. thick; in one or two specimens they are fused together with large spaces between, measuring 10 by 5 cm. The axial corallites are not preserved. The radial corallites are rather distant, spreading at right angles; very short tubular with an oblique aperture; some are sub-immersed and smaller; they vary from 0 to 2 mm. in length, but most do not exceed 1 mm., diameter 1 to 1.5 mm. One cycle of septa is moderately developed, and a second is present in rudiment. Corallum dense, not reticulate in section; surface rather dense, reticulate, with blunt echinulations; wall striate.

Another specimen in the Berlin Museum, from Mauritius (*Möbius*), differs from the types only in the sometimes less-oblique aperture of the radial corallites. Branches 1.5 cm. diameter and under. Axial corallites 2 to 2.5 mm. diameter, 2 mm. exsert. Surface and wall strongly spinose.

Indian Ocean: Mauritius (*Berlin Museum*).

19. *Madrepora robusta*.

Madrepora robusta, Dana, Zoophytes, p. 475, pl. xxxix. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 137; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 40; Quelch, 'Challenger' Reef Corals, p. 151; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18.
 ? *Heteropora cervicornis*, Ehrenberg (*non* Lamarck), Corallenth. d. roth. Meeres, p. 110.

Corallum very stout and laxly branched; branches up to 4 cm. thick and 30 cm. long, terete, only slightly tapering, excepting in some of the terminal divisions, apices blunt. Ultimate branches 5 to 10 cm. long, and simple or occasionally bearing a cluster of smaller branchlets near the apex; diameter 2 to 3 cm. near the base and 1 to 1.5 cm. close to the apex. Axial corallites scarcely distinguishable from the radial tubular ones, rarely 3 mm. diameter (usually 2 to 2.5 mm.), and about 2 mm. exsert. Radial corallites spreading at right angles or nearly so, rather crowded, but of unequal length; about one third are tubular with circular or slightly oval aperture, a little over 2 mm. diameter and 1 to 2 mm. in length; wall rather thick and porous. Those between are dimidiate, nariform, or subimmersed. Directive septa sometimes well developed, the other primaries narrow; a second cycle is usually represented in rudiment. Corallum dense, surface spongy, wall strongly and evenly costate.

Pacific Ocean: Fiji.

<i>a, b.</i> Fiji.	H.M.S. 'Challenger.'	86. 12. 9. 226 & 414.
<i>c, d.</i> —?	Sir E. Home, Bart. [P.].	47. 1. 1. 2 & 3.
<i>e-g.</i> —?	—?	58. 2. 10. 3, 4 & 6.

20. *Madrepora grandis*. (Plate I. figs. A, B.)

Madrepora grandis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 457.

Corallum stout, arborescent, laxly divided. One specimen, which consists of the distal part of a colony, is 36 cm. long, and the main branch is 3 cm. in diameter. Branches simple or forked, some which are 17 cm. long and 2 cm. thick are simple, slowly tapering, attenuate. Near the apex of a colony the divisions are, however, sometimes much shorter and more numerous. Axial corallites 3 mm. diameter, cylindrical, considerably exsert (2 to 3 mm.); wall very porous; star moderate or well-developed. On the distal 5 cm. of a branch the radial corallites are ascending tubular, with thin wall and deep large cup, practically without septa; length 4 to 5.5 mm., usually cylindrical, but sometimes a little compressed, 2 mm. diameter, inner part of the wall as prominent as the outer. Such prominent corallites are about 5 mm. apart, with smaller tubular, nariform, or subimmersed between, diameter about 2 mm.; wall usually thin, but a little thicker in the more elongate corallites. Below the distal 5 cm. (approximately) of a branch, all the radial corallites extend at right angles to the axis and none are over 2 mm. long; they are tubular in form and become gradually shorter towards the base. The condition differs from that of *M. robusta* in similar situations in the thinner wall, in the absence of a recognizable star of septa, and also in the absence

of dimidiate corallites. Usually the two directive septa are recognizable, but the other primaries cannot be distinguished. Corallum very open and reticulate in section in the more slender parts, but very dense near the base; surface fenestrated and echinulate; wall striate, scarcely echinulate unless near the base.

Pacific Ocean: Great-Barrier Reef.

a-c. Palm Island. Saville-Kent Coll. 92. 6. 8. 60 to 62. (Types.)
d. Herring Island, Bowen. Saville-Kent Coll. 92. 6. 8. 314.

Variety:

a. Rocky Island. Saville-Kent Coll. 92. 6. 8. 261.

b. Branches usually under 1.5 cm. in thickness.

21. *Madrepora formosa*.

Madrepora formosa, Dana, Zoophytes, p. 473, pl. 38. fig. 4, pl. 31. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 146; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Studer, MB. Akad. Wiss. Berlin, 1878, p. 533, pl. ii. figs. 7 & 8; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15; ? Ortmann, Zool. JB. 1889, Bd. iv. p. 504.

Madrepora brachiata, Dana, Zoophytes, p. 474, pl. 38. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 147; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 44; Studer, MB. Akad. Wiss. Berlin, 1878, p. 533; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 12; Ortmann, Zool. JB. 1889, Bd. iv. p. 503.

Corallum shrubby arborescent, slender and much divided. Branches 5 to 12 mm. thick; branchlets often curved, subalternate, proliferous near the apex, 2.5 to 5 cm. long and 7 mm. thick, gradually tapering. Axial corallites cylindrical, 2 mm. diameter, 1 to 2 mm. exsert, aperture small. Radial corallites slender, tubular, all spreading, but the angle varies considerably, often at right angles; diameter 1 to 1.3 mm., length 1.5 to 3 mm., with an occasional elongate and thicker proliferous corallite. The corallites become shorter with a broader base in the older parts of the corallum. A few very short and small tubular corallites occur between the more prominent ones to near the tips of the branches, but none are truly immersed. The primary septa of the axial corallites are very well developed and subequal, second cycle absent or rudimentary; the radial corallites have six moderately prominent septa, the directives being usually best developed. Corallum rather dense; surface dense and finely echinulate, subreticulate in parts; wall substriate, echinulate.

Var. *brachiata*.

Corallum spreading arborescent; branches elongate, straight, 1 to 2 cm. thick, the upper ones often 7 or 8 cm. long. Axial corallites over 1 mm. exsert, short cyclindrical. Radial corallites subequal, short tubular, almost at right angles, becoming wart-like below. Aperture usually oblique but variable, 0.5 to 0.7 mm. diameter. Star distinct, the directive septa prominent. Corallum dense, surface finely granular, wall very minutely striate. (*Dana*.)

The specimens referred by Studer to *M. brachiata* appear to differ only from *M. formosa* in having stouter branches, and I do not think the two forms are specifically distinct. Dana was of opinion that the diameter of the branches in any given species is practically constant, but I doubt if diameter alone has more than a minor value in the discrimination of species.

Indo-Pacific Ocean: Fiji and Sulu Sea, Torres Straits, New Ireland, New Hanover, Sumatra, Singapore, ? Ceylon.

a. Nias Island, Sumatra.

Purchased. 85. 9. 3. 1.

b. Thursday Island.

Saville-Kent Coll. 92. 6. 8. 80.

22. *Madrepora pulchra*. (Plate XXVIII. figs. A, B, C.)

Madrepora cribripora, Bassett-Smith (*non* Dana), Ann. Mag. N. H. 1890, vol. vi. p. 452.

Madrepora orbipora, Dana, var., Ridley & Quelch, in H. O. Forbes' Naturalist in the Eastern Archipelago, London, 1885, p. 44. (The specific name is probably a misprint for *cribripora*.)

Madrepora pulchra, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 468.

Corallum arborescent, branches 1.2 to 1.8 cm. thick, terete, often bearing radiating clusters of branchlets at intervals of 2.5 to 5 cm.; branchlets elongate, simple or subsimple, 3.5 to 9 cm. long, 8 to 12 mm. thick, gradually attenuate; the angle of the branchlets varies from 30° to 90°. Axial corallites cylindrical, 3 mm. diameter, about 2.5 mm. exsert, those of the branchlets rather smaller. Radial corallites all spreading at right angles, excepting near the apex of a branchlet; all are short, tubular, a little variable in length, and exhibiting considerable variation in diameter. Length subimmersed to 1.5 mm., diameter 0.75 to 2 mm. The aperture of the larger corallites is usually a little oblique, and in some cases the inner part of the wall is only slightly developed, whilst the outer is elongate, giving a tubo-labellate form; the inner part of the wall is, however, rarely absent, excepting in the older parts of the corallum, where the majority of the corallites are immersed. The outer part of the wall is usually a little thickened in the larger corallites, but the aperture remains over 1 mm. in diameter. The star of the axial corallites consists of six well-developed subequal primary septa, the second cycle is rudimentary; in the radial corallites the star is rudimentary, the directive septa are usually recognizable, and sometimes two or, more rarely, four others. Corallum very porous, surface reticulate and echinulate; wall striato-reticulate, echinulate in the case of the stouter corallites.

Var. *stricta*. (Plate XXVIII. fig. B.)

The specimens from the Tizard Bank referred to *M. cribripora* by Bassett-Smith appear referable to this species. The branches and branchlets are relatively more slender and tapering, and the larger corallites more distant. They are less distinctly tubular than in the type, and rarely over 1.3 mm. diameter; the inner part of the wall is imperfectly developed. The septa are better developed in the radial corallites, but the second cycle is rarely complete even in rudiment, and all are narrow excepting the directives. The whole texture is firmer, and the surface is closely reticulate.

Var. *alveolata*. (Plate XXVIII. fig. C.)

Corallum bushy, closely resembling the type, excepting that the radial corallites are rarely completely tubular, they are usually nariform or half-tubular, sometimes with the inner part of the wall slightly prominent. The prominent ones are more distant than in the type, with smaller ones between. Usually only the directive septa are recognizable in the radial corallites, the inner one often broader than the outer.

Indo-Pacific Ocean: Keeling Island, China Sea, Torres Straits, Great-Barrier Reef.

a. Keeling Island. H. O. Forbes, Esq. [P.]. 84. 2. 16. 1. (Type.)

Var. *stricta*.

a-c. Tizard Bank, 3 fathoms. H.M.S. 'Rambler.' 89. 9. 24. 26. 94 & 95. (= *M. cribripora*, B.-Sm.)

Var. *alveolata*.

a-h. Rocky Island. Saville-Kent Coll. 92. 6. 8. 32 to 38 & 40.
i. Thursday Island. Saville-Kent Coll. 92. 6. 8. 39.
j. Palm Island. Saville-Kent Coll. 92. 6. 8. 204.

23. *Madrepora nigra*. (Plate XXVII. fig. C.)

Madrepora ehrenbergii, B.-Smith (non M.-Edwards & Haime), Ann. Mag. N. H. 1890, vol. vi. p. 452.

Madrepora nigra, Brook, Ann. Mag. N. H. 1892, vol. x. p. 459.

Corallum prostrate, openly reticulate; under surface subcomplanate, almost covered with barnacle-growths; corallites distant and very short, erect, tubular, rarely immersed; upper surface provided with erect or ascending branchlets arranged irregularly, not over 7 cm. long, and about 1.2 cm. thick near the base (including corallites), tapering to a slender apex; apices about 3 cm. apart. Axial corallites cylindrical, 2 mm. diameter, 1 to 2 mm. exsert. Radial corallites on the branchlets, tubular, with an oblique or gutter-shaped apex, spreading almost at right angles, lower margin sometimes convex; the corallites are usually arranged in irregular rows, the majority are elongate and slightly compressed, 2 to 4 mm. long and 1.5 to 2 mm. diameter, with a few subimmersed ones scattered between; the margin is always sharply defined as if cut with a knife; on the main divisions the corallites are similar but not compressed, and the aperture is not so oblique; the average length is 2 mm., and the diameter about the same. The star consists of two cycles of well-developed septa, which extend their full breadth almost to the lip of the corallite, and therefore appear especially well marked; the directive septa are considerably broader and stouter than the others. Corallum dense and stony; surface linear echinulate and pitted, but frequently with a spongy film over the surface; wall distinctly striate, the striæ become broken up into echinulations near the base. The colour of the unbleached corallum is brownish black.

Pacific Ocean: Tizard Bank.

a, b. Tizard Bank, China Sea, 5 fathoms. H.M.S. 'Rambler.' 89. 9. 24. 92 & 93.
 (Types = *M. ehrenbergii*, B.-Sm.)

E. *Prominent corallites of different sizes and shapes intermixed.*a. *Corallum bushy arborescent.*24. *Madrepora valenciennesi*.

Madrepora valenciennesii, M.-Edwards & Haime, Coralliaires, t. iii. p. 137; (? *non* Ortmann, Zool. JB. 1889, Bd. iv. p. 503).

Corallum arborescent, about 18 cm. high; branches cylindrical and subulate, several rising to a similar height from a common base, diverging in all directions, subdivided somewhat as in *M. nobilis*. Main branches 1·8 cm. diameter, gradually tapering to a large axial corallite. Subdivisions spreading and simple up to 8 cm. in length. Axial corallites 4 to 4·5 mm. diameter and 2·5 mm. exsert, with a very thick porous wall; septa in two cycles, both moderately developed. Radial corallites tubular or half-tubular, spreading nearly at right angles; very variable in size, 1 to 2 mm. diameter, the larger ones with a thicker wall. Corallites of various lengths intermixed, those up to 4 mm. in length remain simple, the longer ones bear a few bud-corallites, and the axial corallite is then thickened; there are no truly immersed corallites. There is only one cycle of septa in those corallites not destined to become proliferous; the directive septa are very broad and nearly meet in the middle line, the others are narrow. Corallum very fragile and spongy-reticulate throughout; wall fragile or very porous, striato-reticulate.

The above description is based on the type in the Paris Museum.

Indo-Pacific Ocean: Ceylon, Torres Straits.

a-c. Thursday Island.

Saville-Kent Coll. 92. 6. 8. 63 to 65.

25. *Madrepora laxa*.

Madrepora laxa, Lamarek (*non* Ehrenberg, *non* Brüggemann, &c.), Hist. Nat. Anim. sans Vert. t. ii. p. 280, ed. 2, p. 448; Blainville, Man. d'Actin. p. 390; Deslongchamps, Encyclop. p. 504; Dana, Zoophytes, p. 487; M.-Edwards & Haime, Coralliaires, t. iii. p. 146; (*non* Quelch, 'Challenger' Reef Corals, p. 156).

? *Madrepora pharaonis*, Brüggemann (*non* M.-Edw. & H.), Phil. Trans. 1879, vol. clxviii. p. 574.

Corallum arborescent, laxly branched; branches spreading, terete, slowly tapering. Axial corallites 2 mm. diameter, a little prominent, wall not specially thickened. Radial corallites small, tubular, mostly at right angles or nearly so; crowded and unequal in length in front, becoming short and immersed on the reverse aspect of a branch; diameter 1 to 1·5 mm., length 0 to 2·5 mm. Scattered at rather considerable intervals are a few proliferous corallites of 6 mm. in length and 2 mm. diameter at the apex, spreading at right angles; they form short branchlets at a later stage. Septa variable, usually the directives are of considerable breadth; the outer primaries narrow, and the second cycle still narrower. Corallum moderately porous in section; surface dense, finely tabulato-echinulate throughout; wall not costulate.

The above is a description of the type of Lamarek; the specimen was collected by Péron during his voyage to the East, but the exact habitat is not known.

Var. *fissilabia*.

A variety from the Macclesfield Bank differs from typical specimens in the form of the corallites. These are erect with the outer part of the wall thickened, the inner part thin and not usually so prominent as the outer, often with a slit-like space on the inner aspect.

Indo-Pacific Ocean: Seychelles, Rodriguez, Macclesfield Bank, and Great-Barrier Reef.

<i>a.</i> Seychelles.	H.M.S. 'Alert.' 82. 10. 17. 139.
<i>b.</i> Rodriguez.	Royal Society. 76. 5. 5. 91. (= <i>M. pharaonis</i> , Brügg.)
<i>c.</i> — ?	— ? 37. 6. 10. 11.
<i>d-g.</i> Palm Island.	Saville-Kent Coll. 92. 6. 8. 68 to 71.
<i>h.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 72.
<i>i.</i> Warrior Island.	Saville-Kent Coll. 92. 6. 8. 75.
<i>j, k.</i> Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 77 & 78.

Var. *fissilabia*.

<i>a-h.</i> Macclesfield Bank, 13 fathoms.	H.M.S. 'Penguin.' 92. 10. 17. 33 to 42.
<i>i.</i> Macclesfield Bank, 13 to 23 fathoms.	H.M.S. 'Penguin.' 92. 10. 17. 43.
<i>j.</i> Macclesfield Bank, 13 fathoms.	H.M.S. 'Penguin.' 92. 10. 17. 84.

26. *Madrepora multiformis*.

Madrepora multiformis, Ortmann, Zool. JB. 1889, Bd. iv. p. 504, pl. xi. fig. 2.

Madrepora valenciennesi, Ortmann, loc. cit. p. 503.

Madrepora cf. *formosa*, Ortmann, loc. cit. p. 504.

Corallum variously shaped, arborescent, more or less branched; often much branched and covered with budding branchlets, and then resembling *M. abrotanoides*. Branches 1 to 3 cm. thick. Axial corallites usually 2 mm. broad and 2 mm. exsert, rarely more. Radial corallites very unequal, immersed, nariform, or tubular with oblique, oval, or slit-like aperture. Cœnenchyma porous and finely echinulate. (*Ortmann*.)

The radial corallites are 4 to 5 mm. long, with shorter and immersed ones between; the aperture is oval and oblique and usually opens inwards.

Indian Ocean: Ceylon.

<i>a-f.</i> Ceylon.	Haeckel Coll.	92. 12. 5. 1 to 6.
<i>g-j.</i> Ramesvaram.	Madras Museum.	93. 4. 7. 147 to 149 & 153.
<i>k.</i> — ?	— ?	37. 6. 10. 11.
? <i>l.</i> — ?	— ?	93. 4. 7. 150.

27. *Madrepora multicaulis*. (Plate III.)

Corallum bushy-arborescent, forming broad, much-divided clumps 40 cm. wide or more and 23 cm. high. Branches 15 to 18 cm. long and about 1.8 cm. thick at the base, much divided, especially near the apex, which is usually divided into 3 to 7 radiating branchlets 1 cm. thick, most of which are again divided and proliferous. Axial corallites 3 to 4.5 mm. diameter, but usually 4 mm. or nearly so, and not much exsert; wall very thick and porous. Radial corallites on the distal divisions ascending, dimidiate, the majority subequal, but with a few small between, length 3 mm., diameter 1.5 mm., wall a little thickened but very porous; a variable number, chiefly near the apex, are thicker and bear buds. On the middle sections of the branches the prominent corallites are rather distant, short, thick, nariform, often 2.5 mm. wide, with subimmersed ones scattered between; nearer the base all are small and immersed or subimmersed. Star distinct in the prominent corallites, the directive septa broad; in the immersed corallites the directive septa are scarcely more prominent than the others. Corallum very porous; surface spongy above, evenly reticulate below; wall striato-reticulate and echinulate.

Indian Ocean : Ramesvaram.

a, b. Ramesvaram. Madras Museum. 88. 11. 25. 10 & 93. 4. 7. 151. (Types.)

b. Corallum massive, more or less complanate, with numerous labellate corallites.

28. *Madrepora ehrenbergi*.

Madrepora ehrenbergii, M.-Edwards & Haime (*non* B.-Smith), Coralliaires, t. iii. p. 143.

Madrepora scandens, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 26, pl. ii. fig. 6, pl. iv. fig. 3, pl. ix. fig. 21; Ortmann, Zool. JB. 1888, Bd. iii. p. 150.

The following is a description of the type of M.-Edwards in the Paris Museum :—

Corallum erect, forming a confused arborescent clump with frequent fusions. Branches about 1.2 cm. thick, bearing branchlets at an angle of about 45°, frequently opposite, and 8 mm. diameter near the apex. Axial corallites probably 2 to 2.5 mm. diameter and 2 mm. exsert. Radial corallites at an angle of 45°, or wider in the case of the larger ones. About one third are cylindrical with an oblique aperture, 4 mm. long and 1.5 mm. diameter; the remainder are shorter and smaller, nariform to subimmersed. Some distance below the apex the larger corallites become thickened, the aperture is less oblique, and they bear 2 or 3 small bud-corallites; this condition indicates the transition to independent branchlets. Corallum stony, little perforate; surface echinulate, not reticulate; wall striato-echinulate.

A fine fan-shaped specimen in the collection of the British Museum, 70 cm. wide and 60 cm. high, is intermediate in form between the type and *M. scandens*, Klunz. The main branches are 4 cm. thick at the base and clothed with short spreading tubular corallites at the back, which extend about halfway up the corallum. Near the upper extremity there are almost as many branchlets and prominent corallites on the posterior as on the anterior

surface, and the fusions are almost confined to the lower part of the colony. Ultimate divisions often 4.5 cm. long and only 5 mm. thick, gradually tapering, but a few of the branchlets near the base are thicker and more distinctly acuminate. Tubular and proliferous corallites very spreading, 0.4 to 1.8 cm. long, 2 mm. diameter at the apex and 3 mm. at the base, or more in the case of elongate ones which bear a number of very short open nariform buds. The smaller corallites between the tubular ones vary in shape as in var. *scandens*. The tubular corallites have 6 rather narrow subequal septa; the star is scarcely developed in the shorter and immersed ones, but sometimes one or both the directive septa may project a little. Corallum moderately porous; surface striato-echinulate or reticulate and echinulate; wall finely striate and echinulate or the striae may not be apparent.

Var. *scandens*, Klz.

The characteristic feature of the form figured by Klunzinger consists in the fact that the majority of the branchlets are short, stout, oblique, and taper suddenly at the apex, but others are more slender and gradually tapering as in the forms already described. The axial corallites are 2 to 3 mm. long and broad, but on the young budding branchlets they may attain a length of 6 mm. The radial corallites are of very variable length and form, appressed and often crowded, so as to obscure the coenenchyma. Some are tubular, 4 to 6 mm. long, with or without buds, and only differ from the axial corallites in the oblique aperture; between these many are short, dimidiate, or with the outer part of the wall pointed or almost absent; lower down many are verruciform with variously directed aperture, or completely immersed. Corallum porous; surface striato-echinulate, the echinulations often plate-like and not crowded, on a ribbed, rarely reticulate and trabecular ground; wall finely striate.

I can confirm the statement of Klunzinger that Ehrenberg's *Heteropora pocillifera*, the type of which is in Berlin, is not identical with *M. ehrenbergi*, as Milne-Edwards supposed. Although the name was evidently suggested by this supposed identity, there is no doubt that Milne-Edwards had before him the Paris Museum type at the time, and his description was based on that specimen, and not on Ehrenberg's; his name therefore has priority.

Indian Ocean; Red Sea; Persian Gulf.

a. Red Sea.	J. A. W. Harper [P.] 78. 3. 18. 1.
b. Koseir, Red Sea.	Klunzinger Coll. 86. 10. 5. 8. (Var. <i>scandens</i> .)
c. Persian Gulf.	A. S. G. Jayakar, Esq. [P.] 92. 1. 13. 1.

29. *Madrepora clathrata*. (Plates V., VI. figs. A, B.)

Madrepora clathrata, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 459.

Corallum fan-shaped, reticulate, 30 cm. high, breadth across the upper part 33 cm., but becoming rapidly narrower below. A main stem is absent, and the branches in the lower part have a diameter of about 1 cm.; their subdivisions are at first only slightly spreading, but become more divaricate above. The branchlets are numerous, 2 to 4 cm. long and 5 mm.

thick, frequently arched and laid across one another at various angles, the whole fused together into an irregular network, the meshes of which vary from 4 to 12 mm. across. Axial corallites 2 mm. diameter, 1 to 2 mm. exsert; wall rather thick and cylindrical, with a flat or slightly rounded apex; the star consists of six subequal septa of moderate development. Radial corallites on the anterior (superior?) surface very unequal, not very crowded; the larger ones are tubular, at right angles, with an oblique aperture, from 3 to 4 mm. long and about 2 mm. diameter, but frequently a little compressed; a few are longer and proliferous, the remainder are less spreading, shorter, tubular, tubo-nariform, and nariform to sub-immersed; the only true immersed corallites on the upper surface occur in the lines of fusion. Star imperfect, the directive septa moderately developed, but the others are rudimentary or wanting. The radial corallites on the posterior (inferior?) surface are distant, very short, chiefly subimmersed or cochleariform. Corallum very porous; surface closely reticulate and echinulate, the echinulations often plate-like. Wall of the axial corallites and of the elongate radial ones costate above, the costæ being echinulate below; wall of the remaining radial corallites echinulate in rows.

Another and a larger specimen in the collection appears to belong to this species and to represent a fuller differentiation of the corallum. The specimen is about 96 cm. long and 65 cm. broad, with a very broad base consisting of several stout branches fused together; the branches are 2 cm. thick at the base and 1 cm. at a distance of about 10 cm. from the apex of the corallum. The ultimate divisions form arched branchlets on the anterior surface, 4 to 5 cm. long in the upper part of the corallum, but shorter and more stunted below. The proliferating corallites give rise to short erect branchlets, and the majority of the shorter corallites on the anterior surface are nariform or labellate. On the posterior surface the corallites are not so short and irregular as in the smaller specimen, and they usually stand off at right angles. The majority are very short tubular or subimmersed, others are more prominent, up to 2 mm. in length, and a few form sublateral proliferations.

A similar large fan-shaped specimen has been recently acquired and is 65 cm. high.

Indian Ocean: Mauritius.

a. Mauritius.	Purchased.	93. 4. 7. 78.	(Type.)
b. —?	Waller Coll.	90. 3. 29. 1.	
c. Indian Ocean?	Purchased.	93. 4. 7. 79.	

30. *Madrepora irregularis*. (Plate XIV. figs. E, F.)

Madrepora alces, Brüggemann (*non* Dana), Phil. Trans. vol. clxviii. 1879, p. 576.

Madrepora irregularis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 458.

Corallum consisting of alciiform plates with marginal, erect, digitiform branchlets, or of short, thick, plate-like clusters of incipient branchlets from a narrow base. In the latter case the plates are about 8 cm. high, 11 cm. broad, and 3 to 5 cm. thick, usually 3 or 4 radiating from the same base. Under surface uneven, with short appressed corallites. Upper surface of the plates composed of very numerous and irregular incipient branchlets with immersed and subimmersed corallites between, much as in *M. efflorescens*, but more irregular.

Proliferous clusters very variable in diameter, up to 2 cm., but not over 1·5 cm. long. Axial corallites cylindrical, 2 mm. diameter and up to 3 mm. exsert, usually with thick wall. Radial corallites dimidiate or labellate; wall thin but firm, usually thicker in the outer part of those destined to form axial corallites; very unequal in length, the more prominent ones about 1·3 mm. diameter. Star not well developed, often only the directive septa recognizable. Corallum moderately porous; surface reticulate; wall striate, echinulate near the base.

One of the Rodriguez specimens referred to *M. alces*, Dana, by Brüggemann indicates the formation of plates by the fusion of short proliferous branches 5 cm. long and 1·3 cm. thick. Another specimen consists of an alciform lobe 27 cm. long and 20 cm. across the broadest part, with marginal, erect, proliferous branches, up to 13 cm. long and nearly 3 cm. thick.

Rodriguez; China Sea.

<i>a, b.</i> Rodriguez.	Royal Society [P.]. 76. 5. 5. 89 & 90. (Types = <i>M. alces</i> , Brügg.)
<i>c.</i> Macclesfield Bank, 7 to 8 fath.	H.M.S. 'Penguin.' 92. 10. 17. 65.
<i>d, e.</i> — ?	— ? 93. 4. 7. 72 & 73.

F. Numerous tubular corallites develop a rosette of bud-corallites around the base, most of which do not lead to the formation of branches.

31. *Madrepora decipiens*. (Plate XIV. figs. B to D.)

Madrepora decipiens, Brook, Ann. Mag. N. H. 1892, vol. x. p. 456.

Corallum consisting of stout subprostrate branches with erect digitiform branchlets, or more slender and irregularly fastigiata. Radial corallites of two types—the one stout and often bearing buds, the other thin-walled, labellate or subimmersed.

Form *a*.—Branches subprostrate, 2·5 to 3·5 cm. diameter, provided with erect, tapering, digitiform branchlets often about 3·5 cm. apart at the apex; often simple, 6 cm. long and 2 cm. diameter; in other cases the branchlets are more slender and divided near the apex. Axial corallites cylindrical, 2·5 to 3 mm. diameter, not over 2 mm. exsert; the star consists of 12 equal and very narrow septa, or of an equal and moderately-developed primary series and a narrower second cycle; in either case the directive septa are not more prominent than the others of the same cycle. Radial corallites crowded, of two kinds—the one stout and prominent, the other labellate, subimmersed or immersed. The prominent corallites are cylindrical, with a more or less deep notch in the inner part of the wall; near the apex of a branch they are usually more or less ascending, but all are at right angles on the stouter parts; diameter 2 to 2·2 mm., length 2·5 to 6 mm.; the corallites are longest near the apex of a branch and the inner part of the wall is here scarcely shorter than the outer in many cases, but the aperture is often somewhat elliptical owing to the wall being thinner on the inner side; the length varies considerably in different branchlets, but those on the same branchlet are usually subequal; wall firm, margin not rounded, aperture fully 1 mm.; the longer ones often bear one or two buds. Between the prominent cylindrical corallites numerous

small labellate or subimmersed ones occur. The cylindrical corallites are not developed on the under surface of the main divisions, and on the upper surface there is usually not such a marked difference between the two types of corallite; the more prominent ones have the inner part of the wall more or less incomplete and those between are chiefly immersed. Star usually not recognizable, even in the stouter corallites, and when present is situated deep down in the cup, so that it is scarcely seen from above, often easiest to make out in the immersed corallites on the stouter divisions. Corallum dense; surface reticulate and echinulate; wall deeply and closely striate (rugose), echinulate at the base.

One specimen from the same locality as those belonging to form *a* has the same habit and similar stout ascending branchlets, but the corallites are short and subequal with a few immersed or labellate ones between, so that the divisions have a neat terete appearance. Specimens from Thursday Island resemble those from Rocky Island Reef (form *a*) in habit, but the radial corallites are rarely so stout and have a more oblique aperture.

Form *b*.—Corallum fruticose from an incrusting base; colony about 20 cm. high and 28 cm. wide; branches 1.5 to 2 cm. thick, considerably subdivided. Radial corallites usually 3 to 4 mm. long and about 2 mm. diameter; the form is somewhat tubo-labellate, the inner part of the wall being thin and short, the outer part of the wall usually bears one or more small bud-corallites. In some cases such proliferous corallites may form twigs 6 to 10 mm. long and 5 or 6 mm. thick. Immersed or subimmersed corallites are numerous and are scattered between the prominent ones quite to the apex of a branch, as in form *a*. Specimens in which the proliferations are well marked bear a general resemblance to *M. florida*.

Pacific Ocean: Torres Straits, Great-Barrier Reef, Solomon Islands, ? New Hebrides.

Form *a*.

<i>a-e</i> . Rocky Island Reefs.	Saville-Kent Coll.	92. 6. 8. 81 to 85. (Types.)
<i>f</i> . Rocky Island Reefs.	Saville-Kent Coll.	92. 6. 8. 86. (Var.)
<i>g</i> . Low Woody Island Reefs.	Saville-Kent Coll.	92. 6. 8. 87.
<i>h-j</i> . Thursday Island.	Saville-Kent Coll.	92. 6. 8. 91 to 93. (Var.)
<i>k, l</i> . Green Island.	Saville-Kent Coll.	92. 6. 8. 135 & 136.
<i>m-q</i> . Rocky Island.	Saville-Kent Coll.	92. 6. 8. 139 to 143.
<i>r</i> . Low Woody Island.	Saville-Kent Coll.	92. 6. 8. 308.
<i>s, t</i> . Sta. Anna Is., Solomon Islands.	Dr. Guppy [P.].	84. 12. 11. 26 & 27.
? <i>u</i> . Mola Is., New Hebrides.	W. Wykeham Perry, Esq. [P.].	75. 10. 27. 32.

Form *b*.

<i>a-c</i> . Capricorn Island.	Saville-Kent Coll.	92. 6. 8. 88 to 90.
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32. *Madrepora listeri*. (Plate XXX. figs. C, D.)

Corallum subarborescent, oblique, incrusting dead coral, with numerous fusions. Main branches 18 cm. long, circular, 1.5 cm. thick, gradually tapering, laxly divided, the subdivisions not very spreading, arched upwards a little towards the apex. Axial corallites cylindrical, 2.5 mm. diameter, 1 to 2 mm. exsert. Radial corallites unequal in size. Near the apex of a branch the majority are rather crowded, a little compressed, tubular, with the aperture more

or less oblique, ascending, with the apex a little recurved, 3 to 4 mm. long, 1.5 mm. thick, with a few smaller nariform or subimmersed ones between. A little distance below the apex many of the prominent corallites are more spreading, 2 mm. thick, and bear a few small, round, nariform buds; in some parts these proliferous corallites are almost wanting, but in others they are quite numerous and may occasionally give rise to branchlets 1 to 2 cm. long, in other cases they form short rosettes similar to those of *M. florida*; wall a little thickened, firm but porous. Nearer the base of the branches the corallites are shorter, but completely immersed ones are rare. The star consists of 12 septa, which are not well developed, but the directives are moderately broad in the prominent corallites. Corallum moderately porous; surface reticulate and echinulate; wall faintly striato-reticulate and finely echinulate.

Var. *conica*. (Plate XXX. fig. C.)

Corallum cespitose from a broad incrusting base. Branches spreading, short, thick, conical, 6 to 8 cm. long and 3 to 3.5 cm. thick, covered with "rosettes" and short proliferations. A number of the rosettes, especially on the outer sides of the branches, become elongate (1.5 to 4.5 cm.) and proliferous, the longer ones being situated near the base. The aperture of the central corallite of a rosette is usually circular or nearly so, and there is a general absence of the notched condition which occurs in *M. florida*. The surface of the corallum is reticulate and echinulate; wall striato-echinulate.

A specimen from the same locality without rosettes, but with numerous elongate tubular corallites, with or without buds, appears to represent an earlier condition in the differentiation of the colony in this variety.

Pacific Ocean: Tongatabu.

a. Tongatabu.

J. J. Lister, Esq. [P.]. 91. 3. 6. 6. (Type.)

Var. *conica*.

a, b. Tongatabu.

J. J. Lister, Esq. [P.]. 91. 3. 6. 5 & 8.

33. *Madrepora florida*.

Madrepora florida, Dana, Zoophytes, p. 466, pl. xxxvii. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 141; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15.

The following is Dana's description:—

"Arborescent, very large, broad, and remotely ramose; branches 1.25 in. thick, gradually tapering, bearing over the surface small clusters of polyps. Corallum covered with calicular tubercles $\frac{1}{4}$ of an inch broad; calicles unequal, very short tubiform, rather stout, striated; some tubo-nariform with immersed cells interspersed; star 6-rayed, distinct, two of the lamellæ not more prominent. The rosettes consist generally of 6 to 10 very short calicles; they cover regularly the whole surface. Between these rosettes the cells are mostly immersed."

A number of specimens in the collection appear referable to this species, but all differ more or less from the above description.

Form A. *florida*.

Corallum erect, arborescent; main branches spreading, but their subdivisions are little divergent; branches thick and elongate (25 cm.), scarcely tapering, 3.5 cm. diameter near the base and 3 cm. up to within 3 or 4 cm. of the apex. Rosettes about 1 cm. high and 7 mm. broad, but a few are considerably larger. Axial corallites 2 mm. diameter, sometimes 3 mm. exsert, often a little compressed; aperture round or slightly oval; wall firm but not specially thickened. The central corallites of the rosettes have the same dimensions, but the aperture is more or less oblique; usually the aperture is oval, with a notch in the wall at one or both extremities. Radial corallites of the rosettes spreading, sometimes nariform, more usually half-tubiform or labellate, of variable length up to 2.5 mm. or even more; lip 1.3 mm. broad. Between the rosettes the corallites are nariform, labellate, or immersed, the immersed form increasing in number some distance below the apex. The apex of a branch often shows the formation of the rosettes. At first a few radial corallites become elongate and thicker (4 mm. long and 1.6 mm. thick), with or without one or two radial buds; those between are labellate or nariform, not over 1 mm. diameter and 2.5 mm. long. Corallum very porous, but becoming dense below; surface dense and echinulate; wall closely striate, the striae more or less echinulate. The star consists of 6 narrow septa in the axial corallites, in the radial ones usually only the directives are noticeable.

A specimen from Malacca, which I take to represent an earlier condition of this form, differs in the almost complete absence of proliferations worthy of the name "rosette," and in consequence the branches are not so thick, scarcely over 2 cm. The condition of the surface of the whole specimen, which is 32 cm. high, is very similar to that of the apical 3 or 4 cm. of a branch in the more typical form. The stouter corallites are frequently not yet proliferous, and at most bear 3 or 4 short buds.

Form B. *confluens*.

? *Madrepora horrida*, B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 452.

Corallum forming a frond composed of confluent branches. Base oval, 10.5 by 6 cm.; branches 2 to 3 cm. thick, about 30 cm. long, chiefly in one plane, the subdivisions frequently arched. The upper surface bears a large number of rosettes, from 5 to 15 mm. high, but chiefly about 8 mm. The interval between the rosettes as in form A, excepting that some of the labellate corallites are more elongate. Under surface without rosettes or very prominent corallites; they are chiefly suberect nariform, short tubular or labellate, with immersed ones scattered between. Corallum extremely porous; surface reticulate above, becoming firmer below, echinulate; wall finely striate, echinulate.

A number of other massive specimens in the Collection are probably referable to this variety, and the specimens referred to *M. horrida* by Bassett-Smith appear to me to be an incrusting form in which the rosettes are not well marked.

Pacific Ocean: Fiji, Tongatabu, Louisiade Archipelago, Malacca, ? Tizard Bank.

Form A. *florida*.

a. — ?

— ? 93. 4. 7. 61.

b. Malacca.

Capt. Belcher, R.N. [P.]. 42. 11. 28. 3. [Early stage.]

Form B. *confluens*.

a. Louisiade Archipelago.

J. Macgillivray, Esq. [P.]. 51. 9. 29. 32.

b. — ?

Purchased. 56. 2. 18. 21.

c, d. — ?

— ? 93. 4. 7. 62 & 63.

? e, f. Tizard Bank, 2 fath.

H.M.S. 'Rambler.' 89. 9. 24. 101 & 168. (= *M. horrida*, B.-Sm.)34. *Madrepora tuberculosa*.

Madrepora tuberculosa, M.-Edwards & Haime, Coralliaires, t. iii. p. 135; Ortmann, Zool. JB. 1888, Bd. iii. p. 148; ? Faurot, Arch. Zool. Expér. t. vi. 1888, p. 119.

Corallum consisting of tufts, the divisions of which are large, very short, proliferous, and often forming tubercles rather than branches. Axial corallites tubular, with a thick wall, little prominent, and 2·5 to 3 mm. diameter. Radial corallites of two kinds, the one completely immersed, the other tubiform, 3 to 4 mm. long, and about 2 mm. diameter; wall reticulate and often subnariform. Cœnenchyma reticulate, very porous. Diameter of the terminal branches 1·5 cm. or more; of the main branches 4 to 5 cm. or more, at a distance of 8 cm. from the apex. (*M.-Edwards*.)

The position of this species is uncertain. The type specimen does not appear to be preserved in the Paris Museum.

The specimen from Fiji referred by Ortmann to this species has the following characters:—Base incrusting; branches conical or blunt at the apex, 1·7 to 7·5 cm. long and 2·5 cm. diameter at the base, not including the proliferous corallites. Axial and proliferous corallites 3 to 3·5 mm. diameter; wall thick; margin sometimes slightly rounded. Radial corallites tubular, 1·5 mm. diameter, not over 2 mm. long near the apex of a branch, a little ascending at first and sometimes the inner part of the wall is not fully developed, but becoming longer, proliferous, and more spreading lower down. A little below the apex the majority of the corallites are immersed, with tubular proliferous ones between; these are 3 to 6 mm. long and 3 to 5 mm. apart, but some attain a length of 2·5 cm. and are 1 cm. thick at the base. Bud-corallites chiefly nariform, with the wall a little thickened, some are appressed tubular. The star consists of 12 narrow septa, but the directives are rather broader in tubular corallites. Corallum dense; surface densely echinulate and reticulate; wall striate and rough.

This specimen may be correctly identified, but the definition of Milne-Edwards is too incomplete to settle the question, and the species was not associated by him with *M. florida*. Ortmann's specimen comes very close to my *M. listeri*, var. *conica*.

Indo-Pacific Ocean: Red Sea, ? Fiji.

35. *Madrepora austera*.

Madrepora austera, Dana, Zoophytes, p. 478; M.-Edwards & Haime, Coralliaires, t. iii. p. 144; Verrill, Bull. Mus. Comp. Zool. vol. i. 1864, p. 41; Studer, Mitth. naturf. Ges. Bern, 1880, p. 19; Ortmann, Zool. JB. 1888, Bd. iii. p. 150; ? Quelch, 'Challenger' Reef Corals, p. 153.

Corallum fruticose, spreading ramose and very proliferous; branches nearly terete and tapering above; with numerous unequal lateral branchlets and proliferous corallites. Corallum scabrous; axial corallites 2 to 3 mm. broad, exsert; radial corallites ascending, rather crowded, tubiform and tubi-nariform, 2 to 5 mm. long, rough and striate, aperture circular; star distinct but deep, 6-rayed, with the directives most prominent. Grows in clumps 15 cm. or more in height. (*Dana*.)

Dana remarks that "the species is near the *abrotanoides* (i. e. *M. polymorpha*, mihi), but differs in its harsher surface and strongly striate calicles; moreover, obsolescent calicles are rare." The origin of the type specimen is not recorded.

The specimen recorded by Quelch is much broken and worn, and is only doubtfully referred to this species.

Indo-Pacific Ocean: Singapore, ? Philippines.

? *a.* Mactan Island, Philippines.

H.M.S. 'Challenger.' 86. 12. 9. 220.

G. Branches provided with numerous proliferous corallites which lead to the formation of distinct twigs.

36. *Madrepora abrotanoides*.

Madrepora abrotanoides, Lamarck (*non* Dana), Hist. Anim. sans Vert. t. ii. p. 280 (ed. ii. p. 448); Blainville, Manuel d'Actin. p. 390; Lamouroux, Exposit. Méthod. p. 63, ? pl. 57; M.-Edwards & Haime, Coralliaires, t. iii. p. 140; ? Quoy et Gaimard, Voyage d'Astrolabe, t. iv. p. 232, pl. xix. figs. 1 & 2; Ortmann, Zool. JB. 1888, Bd. iii. p. 150 (*non* Studer, MB. Akad. Wiss. Berlin, 1878, p. 535).

? *Madrepora muricata*, Ellis & Solander, Zoophytes, pl. lvii.

Madrepora danae, Quelch (? *non* Verrill), 'Challenger' Reef Corals, p. 151.

Corallum in tufts of stout divergent branches, bearing numerous subtuberculiform proliferations, disposed irregularly throughout their whole length. Main branches very thick at the base (3 to 5 cm.), about 20 cm. long, often rapidly tapering to a relatively slender and proliferous apex, and thus appearing subconical; little subdivided, excepting at the apex. In other cases the branches are more slender, only slightly tapering, and extended obliquely. Axial corallites 2.5 to 3.5 mm. diameter and 2 to 3 mm. exsert; aperture about one third the diameter; wall thick, and rounded a little above. The whole surface of the main branches is studded with numerous spreading tubular corallites, ultimately similar to the axial ones, but at first having the inner part of the wall little developed. They appear first as short curved nariform corallites, which on the formation of the inner part of the wall become stout,

spreading tubular, 4 to 5 mm. long and 2 to 2.5 mm. diameter, margin narrowed above; the larger ones bear 2 or 3 bud-corallites. Between the prominent corallites already described numerous immersed, subimmersed, or half-tubular ones with a relatively thin wall occur, from 1 to 1.5 mm. in diameter. Septa of the axial and tubular proliferous corallites in two cycles, moderately developed, those of the small radial corallites have broad directive septa and a rudimentary secondary cycle. In the immersed corallites all the septa are narrow. Corallum porous; surface spongy, spinous; wall reticulate and echinulate when thin, the echinulations being arranged in lines near the base; in the older parts the corallum becomes denser and the surface finely echinulate.

The specimen in the Paris Museum which I take to be the type of Lamarck has the large tubular corallites at an angle of about 80°, all are proliferous and from 5 to 13 mm. long, bearing radial bud-corallites in proportion to their length. There are from 4 to 6 proliferations distributed to each 2.5 cm. according to size. The space between them is filled in with immersed and short half-tubular corallites, with the wall echinulate and scarcely striate.

The synonymy of this species is difficult to make out, owing to so many forms having been referred to under the same name. The following, at any rate, appear distinct:—

<i>Madrepora abrotanoides</i> , Michelotti.	= <i>Madrepora</i> ? <i>lavandula</i> , Michelin (fossil).
<i>M. abrotanoides</i> , Audouin.	= <i>Montipora cristagalli</i> , Ehrb.
<i>M. abrotanoides</i> , Ehrenberg.	= <i>Madrepora erythræa</i> , Klunz.
<i>M. abrotanoides</i> , Dana.	= <i>Madrepora polymorpha</i> , Brk.

Pacific Ocean : Tahiti, Great-Barrier Reef, Singapore.

<i>a, b.</i> Tahiti.	H.M.S. 'Challenger.' 86. 12. 9. 80 & 279. (= <i>M. danæ</i> , Quelch.)
<i>c, d.</i> —?	Purchased. 44. 6. 10. 2 & 7.
<i>e.</i> —?	—? 93. 4. 7. 60.
<i>f.</i> Singapore.	G. B. Sowerby, Esq. [P.]. 93. 4. 7. 59.
<i>h.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 279.

37. *Madrepora danæ*.

Madrepora deformis, Dana (*non* Michelin), Zoophytes, p. 484, pl. xliii. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 149.

Madrepora danai, M.-Edwards & Haime, Coralliaires, t. iii. p. 560 (errata).

Madrepora danæ, Verrill, Bull. Mus. Comp. Zool. vol. i. 1864, p. 41; Verrill, in Append. Dana's Corals & Coral Islands, 1875 ed. p. 333; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15 (*non* Quelch, 'Challenger' Reef Corals, p. 151).

Corallum subcespitose, consisting of a few simple or subsimple branches, 15 cm. long and 2.5 cm. or more thick, subterete, obtuse, subproliferous, and often coalescent. Corallites unequal, some are tubular, 4 to 6 mm. long and 2 mm. diameter, others are proliferous and acervate, others again very short, but none are obsolete; exterior striate. (*Dana*.)

It appears probable that this species may prove to be a variety of *M. abrotanoides*, Lamk. (*non* Dana). Judging from the description and figures of Dana, it appears to differ from Lamarck's species chiefly in the following points:—1. The branches are not tapering, and

are obtuse at the apex. 2. There are no apical clusters of short branchlets. 3. Stout proliferous corallites, though not absent, do not form a marked feature. 4. Immersed corallites appear to be entirely or almost entirely absent.

Tahiti.

38. *Madrepora pharaonis*.

Madrepora pharaonis, M.-Edwards & Haime, Coralliaires, t. iii. p. 143 (*non* Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 574).

? *Madrepora pustulosa*, M.-Edwards & Haime, Coralliaires, t. iii. p. 144 (*non* Brüggemann, *non* Klunzinger).

? *Heteropora laxa*, Haeckel, Arab. Korallen, pl. 2. fig. 7 (*non* Ehrenberg, *non* Lamarck, &c.).

Madrepora microcyathus, Klunzinger, Korallenth. d. roth. Meeres, p. 22, pl. iii. fig. 3, pl. iv. fig. 19, pl. ix. fig. 17.

Madrepora scandens, Ridley & Quelch (*non* Klunzinger), in H. O. Forbes's Naturalist's Wanderings in the Eastern Archipelago, London, 1885, p. 44.

Type. Corallum arborescent with stout branches, between which occasional fusions occur, recalling the habit of *M. crassa*. Branches 2.3 cm. thick, 30 cm. long, laxly subdivided. Axial corallites 2.5 mm. diameter, 1.5 mm. exsert; septa in two cycles, the directives scarcely broader than the other primaries. Radial corallites chiefly immersed, with a few labellate, but scattered between are tubular ones almost at right angles, about 5 are distributed to each 2.5 cm.; these are 3 mm. long and 2 mm. diameter, and mostly bear a rosette of short labellate corallites. The tubular proliferous corallites have apparently only 6 septa, the directives much broader than the others. In the immersed corallites the septa are more nearly equal. Corallum moderately porous; surface reticulate and echinulate; wall striate and fragile. (The specimen appears worn.)

Another specimen in the Paris Museum, from the same locality, is labelled *M. pustulosa*, and if this should prove to be the type of M.-Edwards's species it is certainly not distinct from the above. M.-Edwards, however, gives Seychelles as the habitat of his *M. pustulosa*; but so far as I can ascertain there is no specimen of the species from that locality in the collection, and the description given agrees fairly well with this specimen. The specimen here referred to is a fine well-preserved form with the following characters:—Main branches 3 cm. thick, much divided, with numerous spreading and tapering branchlets. Axial corallites 2.5 to 3 mm. diameter, 3 mm. exsert. Radial corallites simple, tubular with oblique aperture, of variable length up to 4 mm., and 1.5 mm. diameter, at an angle varying from 60° to 80°, with short, nariform, labellate and immersed ones between. This is the arrangement on the younger branches; in other parts the tubular corallites become elongate and proliferous, up to 2.5 cm. in length, 5 mm. diameter at the base, with tubo-labellate bud-corallites at an angle of about 60°; the majority of the proliferations are, however, only from 5 to 7 mm. long. This specimen appears to me to give the real characters of the species better than the type.

A third specimen of enormous size, over 1 m. diameter, shows the proliferations still more elongate, forming branchlets averaging 15 mm. in length. All three specimens are from the Red Sea, and were collected by Botta in 1837.

The moderate variation in size of the axial corallites, and the variation in length of the proliferous corallites or branchlets, according to age, has probably led to this species being described under several names. It is significant that all the types of all the forms (? *M. pustulosa*, Edw. & H.) come from the Red Sea.

Indian Ocean : Red Sea, Keeling Island.

<i>a, b.</i> Keeling Island.	H. O. Forbes, Esq. [C.].	84. 2. 16. 50 & 51.
<i>c-d.</i> ———?	——?	93. 4. 7. 82 & 83.

39. *Madrepora gravida*.

Madrepora gravida, Dana, Zoophytes, p. 470; M.-Edwards & Haime, Coralliaires, t. iii. p. 137; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 40; Studer, Mitth. naturf. Ges. Bern, 1880, p. 18.

? *Madrepora brachyclados*, Ortmann, Zool. JB. 1888, Bd. iii. p. 149, pl. vi. fig. 1.

Corallum arborescent, erect or subhorizontal, massive, sometimes with an elongate incrusting base. Form very variable; sometimes the main branches are erect, terete, 3 cm. diameter, with strongly arcuate branches, giving the appearance of a pine-tree, at others the main branches are flattened, extend chiefly in one plane, and may be 10 cm. broad. The branches bear a very large number of short, subcylindrical branchlets, chiefly on the upper surface. The majority are 1.5 to 2 cm. long and 0.7 cm. diameter, chiefly simple, but may be branched or proliferous at the apex. Axial corallites 2.5 to 3 mm. diameter, thick-walled, varying in prominence from 0 to 2 mm. in different specimens. Radial corallites of the branches all immersed or subimmersed; those of the branchlets may or may not be immersed in the basal half, but those of the distal half are always prominent and subequal. They vary, however, considerably in form, and may be nariform, labellate, tubular, or dimidiate; sometimes all forms occur in different parts of the same specimen. The usual type is crowded nariform or short tubular, with the inner part of the wall more or less incomplete, and the outer part thickened a little; length 1 to 2 mm., mostly under 1.5 mm.; breadth 1.5 to 2 mm. The posterior (or inferior) surface of the corallum bears appressed, flattened, half-tubular corallites chiefly, which are irregularly scattered, and may be 3.5 mm. long, but always have a narrow aperture; there are not many immersed corallites on this surface, excepting near the base, where they are much smaller than those above. Corallum rather porous; surface openly reticulate and echinulate; wall striato-echinulate. The corallites usually have 12 well-developed septa, those of each cycle subequal in the axial corallites, but the directives are usually more prominent in the radial ones.

Indo-Pacific Ocean : Singapore, Fiji.

<i>a, b.</i> ———?	Purchased.	56. 2. 18. 28 & 34.
<i>c.</i> Singapore?	Purchased.	53. 6. 7. 3.
<i>d.</i> Singapore.	Purchased.	40. 5. 15. 2.
<i>e, f.</i> ———?	——?	93. 4. 7. 68 & 69.

40. *Madrepora affinis*. (Plate XXVIII. fig. F.)

Madrepora ornata, Brook (*non* DeFrance), Ann. Mag. N. H. 1891, vol. viii. p. 464.

Corallum stout, arborescent; branches elongate, below laxly divided, 2 to 3 cm. thick, often oval in section, divided into a cluster of branches at the apex; the whole densely covered with short ramiculi 8 to 13 mm. long and 5 to 7 mm. thick, and about 1 cm. apart, with numerous very short or immersed corallites between. Axial corallites 3 mm. diameter, 1 to 1.5 mm. exsert; wall thick, margin rounded, aperture about 1 mm. Radial corallites short, round, nariform, with thickened wall and rounded margin, outer wall a little convex, 1.5 to 2.5 mm. long and nearly 2 mm. diameter. On the stouter ramiculi two or three corallites become 3 mm. long and bear three or four buds. The ramiculi are as numerous on the inferior (posterior) surface of the branches as elsewhere, but are usually shorter. Star usually indistinct, but one or both directive septa may be moderately prominent. Corallum moderately porous; surface spongy, echinulate; wall striato-reticulate and echinulate.

The name *M. ornata*, under which this species was originally described, had previously been given by DeFrance to a fossil species, and is therefore now replaced by *M. affinis*. The species is closely allied to *M. gravis*, and may be only a well-marked variety of it. So long as the type specimens were the only ones available for comparison with *M. gravis* there appeared little difficulty in distinguishing the species from one another. More recently, however, a considerable number of specimens from the Great-Barrier Reef area and the Macclesfield Bank have been acquired, some of which show a closer approach to the habit of *M. gravis* than was previously anticipated. Nevertheless the habit is less robust, the branchlets circumaxial, except in complanate specimens, usually not over 1.5 cm. in length, and the apices of the branches are much divided. The radial corallites are shorter, stouter, and more spreading than in *M. gravis*, and the star of septa is rarely well-developed, even in the axial corallites. The corallites are rarely immersed on the basal parts of the twigs, and those between the branchlets are rarely immersed on the distal parts of the corallum; they are usually more or less nariform, or have a ring-shaped border. Those which occur in the lines of fusion are, however, immersed, as is usually the case in such situations.

Pacific Ocean: Great-Barrier Reef, Macclesfield Bank.

<i>a-c.</i> Darnley Island.	J. B. Jukes, Esq. [P.] 46. 7. 30. 29 to 31. (Types.)
<i>d-k.</i> Cleremont Island.	Saville-Kent Coll. 92. 6. 8. 96 to 101, 112 & 113.
<i>l-n.</i> Macclesfield Bank, 13 fath.	H.M.S. 'Penguin.' 92. 10. 17. 14 to 16.

41. *Madrepora compressa*. (Plate XXXIII. fig. F.)

Madrepora compressa, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 452.

Corallum forming a horizontal plate 40 cm. wide and 2.7 cm. thick, from a lateral attachment. Main branches massive, vertically compressed, 3 cm. broad and 2 cm. thick, innately divided; the whole more or less completely fused into a solid plate, with scattered

nariform or short tubular, rarely immersed corallites on the under surface. Branchlets on the upper surface very numerous, erect, very short and stunted, arranged singly or in groups of 2 to 6 in one mass; length 5 to 10 mm., usually not over 7 mm., diameter 4 to 6 mm. if single, but up to 1.5 cm. if clustered. Axial corallites 2 to 3 mm. diameter, not over 1 mm. exsert; wall thick, septa very prominent. Radial corallites crowded, round and spreading nariform or sublabellate, wall thick, aperture wide; diameter 1.5 to 2 mm., length rarely 2 mm. The septa are arranged in two moderately developed cycles, the directives are broadest. The interval between the branchlets is occupied by immersed corallites. Corallum rather dense; surface echinulate; wall striate and echinulate.

The species bears a general resemblance to flattened specimens of *M. affinis*.

Tizard Bank.

a. Tizard Bank, 5 fath.

H.M.S. 'Rambler.' 89. 9. 24. 117. (Type.)

H. *Corallum bushy*. Radial corallites short and spreading, with the inner part of the wall wanting.

42. *Madrepora pocillifera*.

Madrepora pocillifera, Lamarck, Hist. Anim. sans Vert. t. ii. p. 280, ed. ii. p. 448; Blainville, Manuel d'Actin. p. 390; Quoy & Gaimard, Voyage d. l'Astrolabe, Zool. t. iv. p. 236, pl. xix. fig. 5 (not 6-10); Dana, Zoophytes, p. 484; M.-Edwards & Haime, Coralliaires, t. iii. p. 141; Quelch, 'Challenger' Reef Corals, p. 155 (*non* Ehrenberg, Corallenth. d. roth. Meeres, p. 110). *Madrepora laxa*, Quelch (*non* Lamarck), 'Challenger' Reef Corals, p. 156.

The following is a description of the type of Lamarck:—

Corallum subarborescent; branches terete, numerous divided; branchlets gradually tapering to a blunt apex. Axial corallites often very large, with a wide aperture and deep cup; diameter 4 mm., aperture 1.5 to 2 mm., scarcely prominent, wall rounded and porous. Cup with 12 well-developed septa, which gradually taper to the apex, leaving a funnel-shaped aperture. Radial corallites all short and subequal, spreading almost at right angles, flattened hemicotyloid in shape, crowded, about 1.5 mm. long and 2 mm. diameter across the lip, becoming shorter and immersed below; lip usually thin and fragile. Star of the radial corallites consisting of 12 septa; the directives are very prominent, and the second cycle moderately developed. Corallum very porous; surface reticulate and echinulate; wall ribbed.

The 'Challenger' specimens agree well with the above description, but in some the radial corallites are more irregular in length.

Var. *incrassata*.

The form recorded by Quelch as *M. laxa* differs only from the above in having the radial corallites with a thickened lip. The apex of the branch is proliferous, but a similar condition occurs in some of the thin-lipped specimens. The thick-lipped form was obtained

by Quoy and Gaimard at Tongatabu, the specimen is preserved in the Paris Museum. This is the form understood by Dana as *M. pocillifera*.

The Barrier Reef specimens referred doubtfully to var. *incrassata* are difficult to separate from some specimens of *M. millepora* in case the lip is short and thick.

Pacific Ocean: Great-Barrier Reef, New Hebrides, Fiji, Tongatabu, Tahiti.

<i>a-c.</i> Api, New Hebrides.	H.M.S. 'Challenger.'	86. 12. 9. 227, 228 & 413.
<i>d, e.</i> Tongatabu.	H.M.S. 'Challenger.'	80. 11. 25. 231 (part).
<i>f.</i> Port Denison.	Saville-Kent Coll.	92. 6. 8. 24.
<i>g.</i> Lady Elliott Island.	Saville-Kent Coll.	92. 6. 8. 215.
<i>h.</i> Baudin Is., N.W. Australia.	H.M.S. 'Penguin.'	92. 1. 16. 6 (part).

Var. *incrassata*.

<i>a.</i> Fiji Reefs.	H.M.S. 'Challenger.'	86. 12. 9. 231. (= <i>M. laxa</i> , Quelch.)
<i>b.</i> Tahiti.	H.M.S. 'Challenger.'	91. 9. 9. 3. (= <i>M. laxa</i> , Quelch.)
? <i>c-f.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 25 to 27 & 30.
? <i>g.</i> Green Island.	Saville-Kent Coll.	92. 6. 8. 28.
? <i>h.</i> Low Woody Island.	Saville-Kent Coll.	92. 6. 8. 29.

43. *Madrepora aspera*.

Madrepora aspera, Dana, Zoophytes, p. 468, pl. xxxviii, fig. 1; M.-Edwards & Haime, Coralliaires, t. iii, p. 142; Studer, MB. Akad. Wiss. Berlin, 1878, p. 533; Quelch, 'Challenger' Reef Corals, p. 156; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x, p. 12.

? *Madrepora prostrata*, Quelch (*non* Dana), 'Challenger' Reef Corals, p. 163.

The following is a summary of Dana's description:—

Corallum arborescent, spreading, ramose; branches terete, 12 mm. thick, summits conical and proliferous. Corallum quite porous, surface scabrous; axial corallite nearly 3 mm. diameter, a little prominent; the radial short labellate, fragile, divaricate, not crowded, many obsolete; cells quite large, the immersed ones below, 1 mm. broad. Star very short-rayed, the directive septa prominent. The species was described from a fragment 7.5 cm. in length.

The 'Challenger' specimens referred by Quelch to this species appear properly identified, but as they differ in several points from Dana's definition, a description of them is sub-joined:—

Corallum arborescent or bushy, about 21 cm. high; main branches 1.4 cm. diameter, much divided, branches scarcely tapering, and maintaining a diameter of over 1 cm. to within 3 or 4 cm. of the apex. Extremities much divided, many of the branchlets bear proliferations near the apex. Axial corallites 2.5 to 3.5 mm. diameter, about 2 mm. exsert; wall usually thick and porous, strongly costate, but often with large deep funnel-shaped cup, as in *M. pocillifera*, but smaller. Radial corallites crowded, especially above, labellate, spreading at right angles; lip broad, half-tubular in the larger corallites, narrower and more pointed in the others. Maximum length of corallites which remain radial 2 mm., breadth of lip 2 mm., but the majority are smaller; a few immersed corallites are scattered

between on the branchlets; such immersed corallites are more numerous below and on the inferior surface of the branches. Sometimes they are also numerous on the superior surface to within 5 cm. of the apex, and have a few short, labellate corallites scattered between at intervals of 3 to 6 mm. The immersed corallites are smaller than in Dana's type, and rarely exceed 0.7 mm. in diameter. Corallum moderately porous above, but very dense and stony in the older parts; the surface dense and strongly echinulate, a little reticulate above; wall strongly costate, not very fragile, and the larger corallites have the lip a little thickened. Star indistinct in the majority of the radial corallites, the directive septa being narrow and the others rudimentary.

This species shows a strong affinity with *Lepidocyathus* in the form of the corallites and the condition of the septa.

A note on one of the 'Challenger' specimens indicates that this is the most abundant reef-forming species at Mactan Island, Philippines.

A fragment from Samboangan, referred by Quelch to *M. prostrata*, does not belong to that species, but appears to be a marginal fragment of *M. aspera*; the lateral portions of a colony probably extend in a subhorizontal plane.

Apical portions of a colony which get broken readily become fused again to the colony, as has been described by Studer for *M. formosa* and other species.

Pacific Ocean: Philippines, New Hanover, Great-Barrier Reef area, Fiji.

<i>a, b.</i> Mactan Island.	H.M.S. 'Challenger.'	86. 12. 9. 230.
<i>c-e.</i> Mactan Island.	H.M.S. 'Challenger.'	92. 10. 16. 26 to 28.
<i>?f.</i> Samboangan.	H.M.S. 'Challenger.'	86. 12. 9. 219. (= <i>M. prostrata</i> , Quelch.)
<i>g.</i> Warrior Island.	Saville-Kent Coll.	92. 6. 8. 31.
<i>h.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 240.

44. *Madrepora manni*.

Madrepora manni, Quelch, 'Challenger' Reef Corals, p. 150, pl. ix. fig. 1.

Madrepora demani, Rehberg, Abh. nat. Ver. Hamburg, 1892, Bd. xii. p. 33.

Corallum arborescent, laxly branched, subprostrate. Branches terete, elongate, often arranged in pairs arising either just above or below the lateral margin, arcuate, all ultimately directed upwards; they are 8 to 10 cm. or more in length and 1.1 to 1.5 cm. thick at the base, very gradually tapering to 5 or 6 mm. near the apex, then frequently contracted to a rather small axial corallite. Axial corallites 2 to 3 mm. diameter and 1 to 2 mm. exsert; wall strongly costulate, thick, and little porous; septa in two narrow cycles, but the second cycle sometimes nearly as broad as the other. Radial corallites broadly labellate, the upper half of the wall wanting, very crowded, arranged at right angles to the branch, 2 mm. long; lip a little flattened, fragile, 2 mm. diameter near the apex in the more prominent corallites, but showing all stages from immersed through short acicular and narrow labellate to the more fully developed form. The corallites become very short or immersed on the inferior surface of the branches, aperture varying from 0.5 to 1 mm. in diameter, septa scarcely

developed. Corallum very dense; surface covered with rough granules; wall strongly striate, scarcely echinulate.

Philippine Islands.

a. Samboangan.

H.M.S. 'Challenger.' 86. 12. 9. 281. (Type.)

45. *Madrepora scabrosa*.

Madrepora scabrosa, Quelch, 'Challenger' Reef Corals, p. 152, pl. x. fig. 2.

Corallum fruticose, much branched; branches closely crowded, 18 to 24 cm. long and 2 to 3.5 cm. diameter, becoming divided into two or three secondary branches near the base, each of which is again divided, forming branchlets 5 to 12 cm. long and 1 cm. thick, bearing numerous proliferations 6 to 25 mm. long. Axial corallites 2.5, rarely 3 mm. diameter, and 0.5 to 2.5 mm. exsert, wall thick. Radial corallites compressed above, thick and rather appressed tubular at the apex, not crowded, becoming dimidiate, beaked-nariform with an elongate aperture, and passing through swallow-nest shapes to subimmersed. Diameter of the prominent corallites 2 mm., length 5 mm. or under, excepting in the case of proliferous corallites, which are moderately numerous. Near the apex a few small and irregularly arranged corallites occur between the others, opening in various directions. A marked feature of the species consists in the numerous, large, round, subimmersed corallites, with an aperture of 1.5 mm. or over, which extend from the base to within 8 or 9 cm. of the apex. Septa in two cycles, rather narrow; those of each cycle subequal in the axial and subimmersed corallites, the directives more or less prominent in the others. Corallum moderately porous; surface and wall of the corallites finely echinulate, not striate.

Pacific Ocean: Fiji Islands.

a. Fiji.

H.M.S. 'Challenger.' 85. 2. 1. 16. (Type.)

46. *Madrepora divaricata*.

Madrepora divaricata, Dana, Zoophytes, p. 477, pl. xli. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 140; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15.

Corallum shrubby, arborescent, much and spreading ramose, a little proliferous; branches divaricate, arcuate, subterete, 1.7 cm. diameter; branchlets attenuate, 8 to 12 mm. thick. Corallum smooth*; axial corallite 3 mm. broad, exsert; radial corallites remote, divaricate, very stout, scarcely striate, some long tubiform (4 mm.), and 2 to 3 mm. diameter; a few larger and proliferous, many short and round nariform. The cells are all very large; those in the smaller obsolescent corallites about 1.3 mm. broad, and contain a distinct star of 6 rays. Surface of the corallites scarcely striate, though harsh to the feel. From the Fiji Islands. (*Dana*.)

* The term "smooth," as used by Dana, usually indicates that the surface is granular or finely echinulate, in contradistinction to striate or scabrous.

The specimens in the Saville-Kent Collection which I have referred to this species have the following characters :—

Corallum bushy or subcorymbose, resembling *M. arbuscula* in habit. Branches elongate and relatively slender, bent, the divisions spreading, 1 cm. thick, often 8 cm. long, and simple or with short spreading twigs and elongate corallites near the apex. Axial corallites cylindrical, 2·7 to 3·5 mm. diameter, only slightly exsert; star 12-rayed, the septa thin and the primary series subequal. Radial corallites stout, tubo-nariform, distant, becoming gradually shorter, verruciform, and finally immersed. They extend at an angle of about 45°; the average dimensions are—length 4 mm., diameter 2 mm.; the apex is convex, the wall thickened but porous, closely striato-echinulate on the surface, a few small nariform corallites are scattered between the more prominent ones on some of the branches. The longest corallites are situated near the apex of the branches, and give rise to new twigs; some, which are 7 mm. long, are tubular, with the inner part of the wall quite thin, many are over 1 cm. long, and bear several buds on the outer surface. One specimen is subcorymbose, 30 cm. high and 46 cm. broad, with the branches much subdivided, and there is a consequent scarcity of proliferous tubular corallites near the apices. The star of the radial corallites is 12-rayed, but in the prominent corallites of the distal divisions the second cycle is not yet developed.

Indo-Pacific Ocean : Fiji Islands, Great-Barrier Reef area, Amirante Islands, Seychelles.

<i>a-c.</i> Port Denison.	Saville-Kent Coll.	92. 6. 8. 225 to 227.
<i>d, e.</i> Eagle Island, Amirante Islands, 10 fathoms.	H.M.S. 'Alert.'	82. 10. 17. 134 & 142.
<i>f.</i> African Island, Amirante Islands, 10 fathoms.	H.M.S. 'Alert.'	82. 10. 17. 143.
<i>g, h.</i> Seychelles.	H.M.S. 'Alert.'	82. 10. 17. 144 & 157.
<i>i.</i> ——— ?	—— ?	93. 4. 7. 154.

47. *Madrepora squarrosa*.

Heteropora squarrosa, Ehrenberg, Corallenth. d. roth. Meeres, p. 112.

Heteropora forskali, Ehrenberg (part.), op. cit. p. 113.

Madrepora squarrosa, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 13, pl. ii. fig. 9, pl. iv. fig. 12, pl. ix. fig. 9.

? *Madrepora ramiculosa*, Dana, Zoophytes, p. 463, pl. xxxv. fig. 4; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18; Ortmann, Zool. JB. 1888, Bd. iii. p. 154 (*non* Quelch, 'Challenger' Reef Corals, p. 159).

Corallum low, arborescent, 8 to 10 cm. high and broad. Stem 1 to 1·5 cm. thick, with a few much divided divergent branches 1 to 6 cm. long and 5 to 8 mm. thick. Some specimens are more fruticose, with several stems arising from a broad plate-like base. Axial corallites 2 to 3 mm. diameter, wall rather thin, aperture up to 2 mm. Radial corallites small, thin-walled, little spreading, 2 to 3 mm. long and 1·5 to 2 mm. broad, round nariform or a little compressed, aperture 1·5 to 2 mm. long. Corallites quite at the apex 3 mm. long and only 1 mm. wide, only those about to form new buds are quite tubular, with a central aperture. Those on the stouter branches are immersed or a little prominent; all are rather distant.

Corallum somewhat porous; surface as if worm-eaten in places, but in other parts finely echinulate; wall striate. Star prominent, particularly the directive septa.

Indo-Pacific Ocean: Red Sea, Pelew, Ponapé, N. and E. Australia, Tahiti.

- a, b.* N. Australia. J. R. Elsey, Esq. [P.]. 57. 11. 18. 202 & 219.
c. Bellona Shoal, E. of Australia. F. M. Rayner, Esq. [P.]. 62. 2. 4. 18.

2. Subgenus ODONTOCYATHUS.

Corallum more or less complanate. The cylindrical axial corallites are usually provided with only 6 septa, but occasionally there may be indications of a second cycle. A large proportion of the radial corallites are immersed or subimmersed, the more prominent ones are never completely tubular unless proliferous, usually the wall is acuminate. The corallum is very porous and rough on the surface. The species of this subgenus are connected with *Eumadrepora* through *M. scabrosa* &c., and with the *spicifera* group of *Polystachys* through *M. reticulata* and its varieties.

48. *Madrepora arabica*.

Heteropora prolifera, Ehrenberg (*non* Lamarck), Corallenth. d. roth. Meeres, p. 112.

Madrepora arabica, M.-Edwards & Haime, Coralliaires, t. iii. p. 145 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 150).

Madrepora spinulosa, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 23, pl. ii. fig. 8, pl. iv. fig. 11, pl. ix. fig. 18.

The following is a description of the type of Milne-Edwards:—

Corallum arborescent, laxly branched, branches 1 to 1.4 cm. thick, divergent, not much divided, except near the apex, where they bear numerous short stunted branchlets of 4 to 12 mm. in length and 4 to 6 mm. diameter. All the corallites on the main branches and most of the branchlets are immersed, and a little under 1 mm. in diameter. On the terminal 5 cm. of the colony the corallites are short, open tubular, with a very thin wall, the inner portion of which scarcely projects beyond the surface of the cœnenchyma. The largest have the outer wall 2 mm. in length and slightly over 1 mm. diameter. Axial corallites 2 mm. diameter, scarcely prominent; aperture large, with a thin irregular wall. Corallum rather dense (? probably due to secondary deposition of lime); surface composed of vermiform ridges, echinulate, and often confluent; wall and cœnenchyma near the apex consisting of sinuous and dentate plates. Septa scarcely developed at all near the apex of the colony; most of the immersed corallites are practically without septa, in others 6 very narrow primaries may be recognized, of which the inner directive is broadest. (The specimen is worn.)

M. spinulosa, Klunz., is based on Ehrenberg's *H. prolifera*, and is not a species obtained by Klunzinger himself. He appears to have been of opinion that the form might have been referred to *M. arabica*, were it not for the fact that Milne-Edwards describes the surface of his type as "pas subcostulé." This, as will be seen from the above description, is scarcely correct. The surface, although not subcostulate in the ordinary sense, consists of a number of vermiform ridges (as in some other species), which are arranged longitudinally, but

frequently become confluent, and are echinulate or rough; this is precisely the condition described by Klunzinger. The description of Klunzinger, however, differs in several points from that given above, and as it probably represents more nearly the normal characters of the species, the following particulars are appended:—

Corallum arborescent, with long terete, spreading, and acuminate branches, which bear numerous rudimentary and spreading proliferations. Axial corallites 2 to 2.5 mm. broad and 2 mm. exsert, costulate, scarcely broader than the radial corallites; these are rather distant, short, wide nariform or subtubular with the inner part of the wall wanting, 2 to 3 mm. broad and 1 to 2 (rarely 3) mm. long, aperture about 1 mm. A number of short tubular proliferous corallites occur at intervals, which indicate new outgrowths. On the under surface of the branches the wall of the corallites is extremely short, but rarely absent altogether. Corallum rather porous in section; surface strongly ribbed, the ribs spinose and often confluent, with spaces between.

Indian Ocean: Red Sea, Seychelles.

a, b. Seychelles, 4 to 12 fathoms.

H.M.S. 'Alert.' 82. 10. 17. 159 & 146.

49. *Madrepora borealis*.

Madrepora borealis, M.-Edwards & Haime, Coralliaires, t. iii. p. 144.

Corallum closely resembling that of *M. arabica* in habit and density. The type specimen consists of a terminal fragment 8.5 cm. long; diameter of main branch 1.4 cm. Lateral branches numerous, up to 1 cm. in diameter and 5 cm. long, each bearing 2 or 3 proliferous branchlets on the anterior surface; posterior surface mostly void of branchlets and with fewer, shorter, and often smaller corallites. Axial corallites probably 2.5 to 3 mm. diameter, little over 1 mm. exsert, with thin wall and deep cup; septa in two cycles, both moderately developed, the directives only slightly broader than the other primaries. Radial corallites chiefly very short tubular below, 1.5 to 2 mm. diameter, scarcely projecting; the upper ones 3 to 4 mm. long, appressed tubular, with recurved lip, often 2 to 2.5 mm. in diameter. Corallum porous; surface clothed with longitudinal spinose plates connected by a network; wall broadly striate and echinulate, fragile. Septa of the radial corallites in two moderately developed cycles, directives broad.

In spite of the presence of a second cycle of septa, I have felt it necessary to associate this species with *M. arabica* on account of its extremely close resemblance in other respects. I have, indeed, doubts as to whether it is really distinct. In *M. borealis* the corallum is more porous than in the type specimen of *M. arabica*, the corallites have usually a greater diameter; the prominent ones are more numerous, and the septa are much better developed. In *M. spinulosa*, Klunz., which I regard as a synonym of *M. arabica*, the corallum is porous and the prominent corallites are larger (?) and more numerous.

Some mistake has evidently been made in the habitat of the type of this species; it is almost incredible that a species of the genus *Madrepora* should be found in Arctic Seas.

[White Sea, near Archangel.]

50. *Madrepora stigmataria*.

Madrepora stigmataria, M.-Edwards & Haime, Coralliaires, t. iii. p. 145.

? *Madrepora repens*, Rehberg, Abh. nat. Ver. Hamburg, 1892, Bd. xii. p. 36, pl. iv. fig. 8.

Corallum extending subhorizontally from a rounded base in the form of a flattened vasiform fan, with frequent fusions. Main branches lax, with large spaces between, 1.7 cm. diameter near the base. Subdivisions lateral, almost in one plane and becoming gradually attenuated. Ultimate divisions 1 to 3 cm. long, fused at the margin. Axial corallites 2.5 mm. diameter, scarcely exsert; star of 6 subequal septa of moderate breadth, with sometimes a rudimentary second cycle. Radial corallites appressed nariform, with rather thick wall, variable in size, at most 1.75 mm. long and 2 mm. broad, but the majority are sub-immersed; star rudimentary, only the directive septa are recognizable. Corallum dense; surface finely granular throughout; the "granulations" consist of small spines with blunt or irregular apices.

The above description is based on the type in the Paris Museum.

Indian Ocean : Seychelles.

51. *Madrepora subtilis*.

Madrepora subtilis, Klunzinger, Korallenth. d. roth. Meeres, p. 28, pl. ii. fig. 7, pl. iv. fig. 4, pl. ix. fig. 22.

Corallum arborescent, laxly subdivided; the branches chiefly in one plane, with frequent fusions. Branches and branchlets slender and elongate, the stoutest not over 8 to 12 mm. diameter; ultimate divisions 1 to 4 cm. long and only 4 to 5 mm. thick at the base, gradually tapering. Axial corallites 2 to 3 mm. broad, 3 to 5 mm. long. Radial corallites mostly short and small, 2 to 4 mm. long and 1 to 2 mm. broad, very distant, spreading, nariform, and round labellate. Scattered between are a number of tubular corallites 4 to 5 mm. long and 2 mm. broad; aperture small, round or oblique; the larger ones bear one or more lateral bud-corallites. Corallites distant and shorter on the underside of the corallum, more appressed, rarely immersed. Star little prominent. Corallum very porous; surface ribbed, trabecular, with rows of broad flattened echinulations.

A specimen from the Solomon Islands appears to differ only in the absence of fusions and the less complanate branching.

Indo-Pacific Ocean : Red Sea, Solomon Islands.

a. Solomon Islands.

H.M.S. 'Herald.' 55. 12. 7. 150.

52. *Madrepora reticulata*. (Plate IV. figs. A, B.)

Madrepora reticulata, Brook, Ann. Mag. N. H. 1892, vol. x. p. 461.

Corallum complanate and reticulate; largest specimen 36 cm. long and 20 cm. broad. Branches rarely over 7 mm. diameter, forming a network with elongate meshes, which are

sometimes over 8 cm. long and about 8 mm. broad. Under surface of the branches provided with distant, spreading, tubular or tubo-nariform corallites about 1.5 mm. diameter, with scattered immersed ones between; sometimes the immersed corallites are absent, and in one specimen the tubular corallites are proliferous and form twigs about 6 mm. long. The upper surface of the reticulum is covered with suberect labellate corallites, chiefly with a pointed apex; they are 1.3 mm. diameter and 1 to 3 mm. long; wall thin, but firm. Certain of these corallites become tubular and proliferous, and give rise to irregularly grouped suberect twigs, usually about 7 mm. long. Axial and proliferous corallites cylindrical, 2 mm. diameter and 2 to 4 mm. exsert, wall a little thickened. Star imperfectly developed, usually only the directive septa are recognizable. Corallum moderately dense; surface striate and echinulate; wall striate, echinulate near the base.

Var. cuspidata.

A variety from the Macclesfield Bank differs from the type in having normal twigs on the upper surface 1 to 1.3 cm. long and 3 to 4 mm. thick, distinctly tapering, simple or more usually bi- or trifid; corallites nearly all immersed; prominent corallites open, with a narrow labellate lip, star not recognizable.

Pacific Ocean: Amirante Islands, Seychelles, Arafura Sea, Macclesfield Bank.

<i>a-d.</i> Eagle Island, 10 fathoms, Amirante Islands.	H.M.S. 'Alert.' 82. 10. 17. 131, 135, 155 & 93. 4. 7. 141. (Types.)
<i>e.</i> African Island, 10 fathoms, Amirante Islands.	H.M.S. 'Alert.' 82. 10. 17. 187 (part.).
<i>f.</i> Eagle Island, 10 fathoms, Amirante Islands.	H.M.S. 'Alert.' 82. 10. 17. 141. (Proliferous var.)
<i>g.</i> Amirante Islands.	H.M.S. 'Alert.' 82. 10. 17. 115.
<i>h.</i> Seychelles.	H.M.S. 'Alert.' 82. 10. 17. 145.
<i>i-m.</i> Macclesfield Bank, 13 fathoms.	H.M.S. 'Penguin.' 92. 10. 17. 1 to 5.
<i>? n.</i> Evans Bank, 15 fathoms, Arafura Sea.	H.M.S. 'Penguin.' 92. 4. 5. 4.
<i>Var. cuspidata.</i>	
<i>a-f.</i> Macclesfield Bank.	H.M.S. 'Penguin.' 92. 10. 17. 6 to 10 & 13.
<i>? g, h.</i> Macclesfield Bank, 13 fathoms.	H.M.S. 'Penguin.' 92. 10. 17. 11 & 12.

53. *Madrepora oligocyathus*. (Plate VII.)

Madrepora oligocyathus, Brook, Ann. Mag. N. H. 1892, vol. x. p. 460.

Corallum forming a fan-shaped and pedicellate half-vase; length 60 cm., breadth 53 cm., diameter of pedicel 7 cm. The general form of the corallum closely resembles that of *M. microclados*; branches forming an open reticulum, the meshes of which are not usually elongate; diameter of branches 8 to 15 mm.; branchlets on the under surface about 1.5 cm. long and 5 mm. diameter at the base, somewhat tapering, nearly all are a little appressed,

many are short and verruciform; all the corallites on the under surface of the corallum are immersed. Upper surface provided with more numerous suberect branchlets, which usually arise singly; length 1·3 to 2 cm., occasionally more, diameter 4 to 5 mm. at the base; a few are forked, and others near the margin are more important and bear radiating branchlets of a second order. Axial corallites 2 mm. diameter, 1·5 mm. exsert; wall usually very thin; aperture large and round or oval with 6 narrow subequal septa. Radial corallites immersed or subimmersed, excepting near the apex of the branchlets, where a few are short, round nariform; the marginal branchlets usually bear more or less prominent corallites to the base, 1 mm. diameter, and the outer part of the wall rarely over 1·5 mm. long; wall thin, aperture wide and circular; star scarcely developed, but sometimes the directive septa may be recognized. Corallum very porous and fragile; surface striate and strongly spinose; wall striate and echinulate.

Indian Ocean: Mauritius.

a. Mauritius.

Purchased.

92. 1. 3. 4. (Type.)

54. *Madrepora ambigua*. (Plate VIII. fig. C.)

Madrepora ambigua, Brook, Ann. Mag. N. H. 1892, vol. x. p. 451.

Corallum subhorizontal or erect, somewhat flabellate; branches irregularly confluent; height 24 cm., diameter 36 cm. Base incrusting. Basal parts of the branches fused into a solid mass, with mammiform protuberances. Branches 1·5 cm. diameter, bearing on the upper surface a few short arched and blunt divisions scarcely smaller in diameter, but those near the margin may be longer and not quite so thick; length 2 to 4 cm. Axial corallites scarcely prominent unless near the margin of the colony, 2·5 to 3 (rarely 3·5) mm. diameter. Radial corallites very unequal, many are immersed. Prominent corallites irregular in arrangement, chiefly spout-shaped, spreading, unless near the apex of a twig; inner part of the wall not prominent, except in the stouter corallites; outer part thin when short, but thick and keeled, with a rounded margin, in the stouter corallites; length 0·5 to 2·5 mm., diameter 1 to 2 mm. The star consists of 6 moderately developed septa; sometimes the lower directive is very prominent and the others very narrow. Wall strongly striate and dentate or echinulate, surface reticulate and echinulate. On the under surface of the colony the branches are not flattened, but the interval between them may be filled up with cœnenchyma; there are no branchlets springing from the under surface, where the corallites are numerous and all immersed.

Pacific Ocean: Great-Barrier Reef area.

a. Northumberland Island.

Saville-Kent Coll.

92. 6. 8. 278. (Type.)

55. *Madrepora complanata*. (Plate IV. fig. C.)

Madrepora complanata, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 459.

Corallum flabellate, probably about 23 cm. high and 40 cm. broad. The main stem gives

off alternate branches at an acute angle, which may be 20 cm. long and 1.5 cm. thick, spreading out laterally, their subdivisions subalternate and confluent, the whole habit recalling the espalier form of fruit-tree; a few very short branchlets arise obliquely from the anterior surface, but the majority conform to the general plane of growth. Axial corallites 2 to 2.5 mm. diameter, tubular, scarcely exsert; wall not specially thickened, and closely resembling the radial ones, except in shape. Radial corallites on the anterior surface subequal, very spreading, boat-shaped, nariform or labellate, the aperture wide and elongate, the upper margin almost at right angles to the branch, the lower more or less convex, 2.5 mm. long and about 2 mm. thick; wall thickened, apex often a little hooked. The corallites become a little less prominent towards the base of the corallum, but immersed corallites are practically absent. On the inferior surface the corallites are more scattered and irregularly arranged; many open downwards; the majority are appressed, tubular, with only the outer part of the wall free. A few immersed corallites occur, but they are neither numerous nor generally distributed. Corallum moderately porous, reticulate in section; anterior surface subreticulate and echinulate; posterior surface dense and finely echinulate; wall finely striate and echinulate. The star of the axial corallites consists of 6 rather narrow equal septa, together with a more or less incomplete second cycle. The radial corallites have 6 very narrow equal septa, with occasionally indications of a second series.

This species closely resembles *M. stigmataria* in habit, but differs in the almost complete absence of immersed corallites; the prominent corallites have a different shape and a distinct star of 6 narrow septa.

Var. *informis*.

A number of specimens from the Macclesfield Bank are probably referable to this species. The branched reticulum is, however, less flattened and more irregular, recalling the condition in *M. nigra* and some specimens of *M. formosa*. There are no corallites on the under surface, and many of those on the upper surface are round nariform, with a complete or nearly complete margin.

Indian Ocean : Seychelles.

a-c. Seychelles, 4 to 12 fath. H.M.S. 'Alert.' 82. 10. 17. 140, 147 & 148. (Types.)

Var. *informis*.

a-d. Macclesfield Bank, 13 fath. H.M.S. 'Penguin.' 92. 10. 17. 71 to 74.

The following species are also provisionally included in this subgenus:—

56. *Madrepora tortuosa*.

Madrepora tortuosa, Dana, Zoophytes, p. 467, pl. xxxvii. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 144; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19; Ortmann, Zool. JB. 1888, Bd. iii. p. 150.

Corallum cespitoso-arborescent, close-ramose; branches crowded, often coalescing, a

little tortuous, 12 mm. thick below; branchlets often 5 cm. long and 4 to 8 mm. thick, acuminate and subacute; surface of the corallum scabrous, not at all striate. Axial corallite 1.5 mm. long and broad; radial corallites obsolete below 7.5 cm. from the apex; above short, round, nariform, rather distant and fragile; star obsolescent, the directive septa but slightly prominent. (*Dana.*)

The Ponapé specimen referred by Ortmann to this species is 16 cm. high and 24 cm. broad; branches 8 cm. long and 1 cm. thick, slowly tapering, often bent; apices much divided. Axial corallites 2 mm. diameter or slightly over, 1 to 2 mm. exsert, but provided with very small buds to near the margin; wall firm, aperture large. Radial corallites immersed below, then very short, and finally, nearer the apex, nariform or tubo-nariform, unequal in size. A few are proliferous, but scarcely longer than the others; the longest measure 4 mm., and are often a little compressed, 1.2 to 1.5 mm. in diameter; surface spongy, vermiculate, and echinulate; wall finely striato-echinulate. The outer part of the wall is often slightly thickened; and small, thin, or tubular corallites, turned in various directions, are scattered between the others to near the apex.

The species appears very close to *M. implicata*; and Dana's descriptions are insufficient for their proper separation. *M. tortuosa* has stouter branches, more prominent corallites, and a number of small ones opening in various directions. Dana states that the surface of the cœnenchyma is not striate in the type specimen; it is distinctly vermiculate in the Ponapé specimen recorded by Ortmann.

Pacific Ocean: Fiji Islands, Ponapé (Caroline Islands).

57. *Madrepora implicata*.

Madrepora implicata, Dana, Zoophytes, p. 466, pl. xxxvii. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 144; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

Corallum 15 to 20 cm. high, cespitoso-arborescent, closely ramose; branches crowded, curved, and tortuously entangled, often coalescing, slenderly attenuate; stems 8 mm. thick, branches 4 mm. Corallum scabrous and striated, with linear pores. Axial corallite 1.6 mm. in diameter. Radial corallites obsolete below 5 cm. from the summit; above this short, round, nariform or fragile, scattered; star obsolescent. (*Dana.*)

This species may prove to be a slender variety of *M. tortuosa*.

Pacific Ocean: Fiji Islands.

58. *Madrepora pruinosa*. (Plate XXXIV. fig. B.)

Corallum cespito-arborescent, about 12 cm. high and 17 cm. wide; branches 1 cm. thick, 7 to 9 cm. long, usually much divided. Axial corallites 2.75 mm. diameter, usually 2 mm. exsert; wall rather thin. Radial corallites immersed or subimmersed on the main divisions and up to within 4 cm. of the summit, or at most with a few verruciform corallites; more distally the corallites are round, nariform or tubiform, about 2 mm. diameter and 1 to 2.5 mm.

long; aperture circular. Star very prominent in all the corallites; the six primary septa are subequal, and nearly meet in the middle line in the immersed corallites; in the prominent ones the outer directive septum is rather broader than the others.

A small number of immersed or subimmersed corallites have a greater diameter than usual, and are provided with a third cycle of septa; but, as in the case of *M. mirabilis*, the calicles with three cycles of septa do not appear to have any constant position. The corallum is porous and reticulate in section; the surface is densely clothed with equal plate-like echinulations; wall more or less distinctly striate.

<i>a.</i> China (probably South).	Fisheries Exhibition. 84. 2. 26. 10.	} Types.
<i>b.</i> Korea Straits.	J. F. R. Aylen, Esq., R.N. [P]. 62. 7. 16. 33.	
<i>c.</i> Tsu-sima, Korea Straits.	J. F. R. Aylen, Esq., R.N. [P]. 62. 7. 16. 109.	

3. Subgenus POLYSTACHYS.

Corallum cespitose, bushy or corymbose. Axial corallites cylindrical, little variable, usually 2 to 2.5 mm. diameter, usually with a well-developed star of 12 septa. Branchlets on the upper surface spiciform, with relatively large ascending corallites, in which rarely more than the inner one-third of the wall is undeveloped. This subgenus is connected with *Lepidocyathus* through *M. frondosa* and *M. sinensis*.

A. Corallum cespitose, bushy or subcorymbose, but always convex on the upper surface.
Corallites nariform to tubo-labellate or tubular; wall not dense.

a. Branches rarely under 1 cm. in thickness; corallite-wall not fragile.

59. *Madrepora nasuta*.

Madrepora nasuta, Dana, Zoophytes, p. 453, pl. xxxiv. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 153; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; ? Moseley, Proc. Roy. Soc. Lond. 1876, vol. xxiv. p. 549; Quelch, 'Challenger' Reef Corals, p. 154; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16 (*non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 453).

Corallum broad cespitose, from a stout solid base, 15 cm. diameter in a specimen 30 cm. across; below complanate and nearly naked, stout pedicellate; above branchlets crowded, digitiform, nearly simple, rarely proliferous, subterete, 5 to 6.25 cm. long and 8 to 10 mm. thick, subacute, branchlets of the margin horizontal and elongate. Radial corallites very prominent, compressed-nariform, very finely striate; aperture oblong. Star often distinct, the directive septa a little the broadest. (*Dana*.)

In the specimen figured the marginal branches do not appear either elongate or horizontal, and the branches are less simple than one would suppose from the above description.

One of the 'Challenger' specimens referred by Quelch to this species agrees well with Dana's figure, but not so exactly with the description. Corallum 30 cm. broad, 13 cm.

high; base 15 cm. diameter. The branches are about 1 cm. long and 1 to 1.3 cm. thick near the centre of the colony, simple, bifid or trifid, with the subdivisions subparallel; those nearer the margin are shorter and more frequently subdivided; the outer divisions of the marginal branches extend horizontally, but are rarely 3 cm. long. Many of the apices bear short proliferations. Axial corallites scarcely 2 mm. diameter, a little exsert, but provided with bud-corallites almost to the margin. Radial corallites prominent and a little rounded, if within 2 or 3 cm. of the summit, those below usually immersed or subimmersed; prominent corallites nariform, tubo-nariform, or dimidiate, sometimes in longitudinal rows, as indicated by Dana, 2 to 3 mm. long, very spreading, about 1 mm. diameter; wall scarcely thickened; aperture narrow and elongate. A few of the corallites near the summits are stouter and more elongate, and indicate new proliferations. Star not well developed in the prominent corallites, but more marked in those which are subimmersed or immersed. Corallum rather porous above; surface spongy echinulate; wall finely striato-echinulate.

Another specimen from the same locality has more proliferous branches and less spreading corallites, which remain prominent to a greater distance from the summits than in the specimen described above.

Var. *crassilabia*.

Corallum half corymbiform from a lateral attachment. Marginal branches subhorizontal, with numerous stout tubular corallites and short twigs, 7 to 14 mm. long, clothed with subimmersed and immersed corallites. Upper surface with erect digitiform branchlets about 1 cm. thick. Radial corallites prominent, nariform or dimidiate, spreading almost at right angles, with thick dense wall and rounded margin; a few short, nariform corallites are scattered between the others; aperture oblique and elongate, length 2 to 3 mm., diameter nearly 2 mm.; the more prominent ones are arranged in longitudinal rows. The corallites gradually become shorter towards the base of the branchlets, but scarcely any on the superior surface of the corallum are completely immersed. It is possible that Dana's figure represents a specimen with thick-walled radial corallites.

Pacific Ocean: Tahiti, Fiji, ? Capricorn Islands.

<i>a, b.</i> Tahiti.	H.M.S. 'Challenger.' 85. 2. 1. 5 & 85. 2. 1. 4.
<i>c.</i> Fiji.	F. M. Rayner, Esq. [P.]. 62. 2. 7. 1. (Var. <i>crassilabia</i> .)
? <i>d.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 303.

60. *Madrepora paxilligera*.

Madrepora paxilligera, Dana Zoophytes, p. 452, pl. xxxiv. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 157; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Duncan, Journ. Linn. Soc. Lond. 1886, vol. xxi. p. 20; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 17; Ortmann, Zool. JB. 1888, Bd. iii. p. 152 (*non* Quelch, 'Challenger' Reef Corals, p. 154; *non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 453).

Dana gives the following particulars:—

Corallum very broad, cespitose, pedicellate, plane above; base of frond solid, disk-shaped,

5 cm. thick, convex and naked below. Branchlets digitiform, 6 to 7.5 cm. long and 2.5 to 3.75 cm. thick; erect, subterete, rarely furcate, subacute. Margin of colony with short and incipient branchlets. Axial corallites scarcely 2 mm. diameter, scarcely exsert. Radial corallites a little unequal, very crowded, a little prominent, compressed nariform or sometimes dimidiate. Wall striate; aperture oblong; star scarcely distinct.

The specimen recorded by Ortmann agrees well with Dana's figure, but the corallites are scarcely compressed. The colony is 20 to 24 cm. wide, and forms a flattened convex clump with a broad incrusting base. The central branches are erect, digitiform, usually simple, but bear numerous budding corallites and very short proliferations rarely over 5 mm. long and 4 mm. thick; they are 2.5 to 4 cm. long and 1 to 1.5 cm. diameter at the base. The marginal branches are not so stout, often forked, and extend obliquely, projecting 3 to 3.5 mm. beyond the base. Axial corallites 2 mm. diameter, scarcely exsert; wall moderately thick. Radial corallites small and very crowded, 1 mm. diameter; thin-walled, more or less ascending, dimidiate, nariform, labellate or gutter-shaped, with a tapered apex, rarely tubular. Adjoining corallites are very unequal in length, but usually not over 2 mm., though on some of the branches a few may attain a length of 3 mm. The proliferous corallites become completely tubular, and are 3 mm. or more in length. The basal parts of the branches bear immersed corallites, with arched nariform ones between, some of which have the wall thickened and hooked. Star of the radial corallites indistinct, usually only the directive septa are prominent. Corallum dense, but reticulate in section. Wall finely striate, echinulate below. The under surface of the marginal branches bears very short appressed and immersed corallites.

The specimen referred to this species by Quelch differs only in the more unequal corallites from one of those referred by him to *M. nasuta*; both have ascending radial corallites, but may not really belong to this species. The corallites are compressed nariform to dimidiate, with immersed or short corallites between, but are not so crowded as is shown in Dana's figure.

Indo-Pacific Ocean: Tahiti, Fiji, Mergui Archipelago.

? a. Tahiti. H.M.S. 'Challenger.' 82. 5. 1. 6. (= *M. paxilligera*, Quelch.)

61. *Madrepora digitifera*.

Madrepora digitifera, Dana, Zoophytes, p. 454; M.-Edwards & Haime, Coralliaires, t. iii. p. 153 (*non* Studer, MB. Akad. Wiss. Berlin, 1878, p. 530).

Corallum broad, corymbose, with a solid circular base; nearly flat above. Branchlets crowded, digitiform, scarcely terete, subacute, 6 to 7.5 cm. long and 8 to 10 mm. thick, often proliferous. Axial corallites a little prominent, scarcely 2 mm. diameter. Radial corallites crowded, divaricate, dimidiate, erect, not at all compressed, 1.5 mm. long; lip rather thick, with scattered immersed corallites between; all the corallites are obsolescent on the lower part of the branchlets. Wall of the corallites neatly striate; star of 6 narrow septa, the outer directive quite prominent. In the prominent corallites the lower part of the wall extends at right angles to the branch. (*Dana*.)

The species is founded on a specimen in the collection of the Boston Society of Natural History. Its habitat is not recorded.

The specimens which I have referred to this species are subcorymbose, with the branches free. Axial corallites 2.5 mm. diameter, scarcely exsert, with 12 not very prominent septa; the primary cycle subequal. Radial corallites chiefly gutter-shaped and very spreading, with the outer part of the wall thick and porous, the inner very short and thin or absent; length 2 to 4 mm., diameter 2 to 2.7 mm.; the apex is broad and curved in most cases, but occasionally acuminate. The prominent corallites gradually become shorter and verruciform towards the base of the branches. A few of the more elongate corallites bear one or two small buds. Small immersed corallites extend between the others quite to the apex of a branch. The second cycle of septa is incomplete.

Indo-Pacific Ocean : Great-Barrier Reef area, Madagascar.

<i>a.</i> — ?	— ?	93. 4. 7. 137.
<i>b.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 287.
<i>c, d.</i> Capricorn Islands.	Saville-Kent Coll.	92. 6. 8. 288 & 289.
<i>e.</i> Madagascar.	W. Deans Cowan, Esq. [P.].	82. 5. 23. 1. (Var.)

62. *Madrepora effusa*.

Madrepora effusa, Dana, Zoophytes, p. 455; M.-Edwards & Haime, Coralliaires, t. iii. p. 153; Ortmann, Zool. JB. 1889, Bd. iv. p. 506 (*non* Quelch, 'Challenger' Reef Corals, p. 154; *non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454).

Corallum broad, cespitose, convex above; base forming a nearly solid disk; clumps 13 cm. high and 28 to 35 cm. wide. Branchlets crowded, digitiform, 3.8 cm. long and 8 to 10 mm. thick, those at the margin coalescent. Axial corallites stout, cylindrical, rather over 2 mm. broad. Radial corallites compressed nariform, much crowded and unequal, 3 mm. long; but others are quite short, and some are tubo-nariform or tubular and proliferous. Under surface crowdedly covered with short corallites. (*Dana*.)

Dana says that the species resembles *M. nasuta*, but has much more unequal corallites (M.-Edwards states erroneously "plus uniformes"), and the axial corallites are twice as broad. The branchlets are also much shorter, the marginal ones coalescent and the under surface muricate. The type specimen is apparently not preserved in the National Museum at Washington, and unfortunately we know nothing of the diameter and the angle of the corallites or the thickness of the wall &c. The form which I take to be the species named by Dana has rather crowded somewhat ascending corallites, which are very variable in length and form. Many are nariform or tubular, with an oblique or dimidiate aperture; in each case the outer part of the wall is thickened, but porous; the longer ones bear buds; numerous immersed or slender corallites occur between the more prominent ones. Wall striato-echinulate; surface very strongly echinulate.

Indo-Pacific Ocean : Ceylon, Great-Barrier area.

<i>a.</i> — ?	Mantell Coll.	41. 1. 13. 13.
<i>b, c.</i> Palm Island.	Saville-Kent Coll.	92. 6. 8. 283 & 284.
<i>d, e.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 292 & 293. (Var.)
? <i>f.</i> — ?	— ?	93. 4. 7. 117.

63. *Madrepora haime*.

Madrepora haime, M.-Edwards & Haime, Coralliaires, t. iii. p. 151; Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 21, pl. i. fig. 9, pl. v. fig. 4, pl. ix. fig. 16; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45; Ortmann, Zool. JB. 1888, Bd. iii. p. 152 (*non* Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 575).

Madrepora arbuscula, Verrill (*non* Dana), Bull. Mus. Comp. Zool. 1864, vol. i. p. 40.

Milne-Edwards's type of this species consists of a fine cespitose clump, 25 cm. high and about 35 cm. broad. Main branches over 2 cm. diameter, becoming divided into two or three little spreading branches, with numerous subdivisions near the apex. The sudden taper near the apex of the branchlets, caused by the corallites surrounding the axial one being very small, whilst those a little below are much longer, is very marked in Red Sea specimens, but in those from other localities the taper is often gradual. Axial corallites 2 to 3 mm. diameter, and 1.5 to 3 mm. exsert; wall moderately thick. Radial corallites spreading, tubular, with an oblique aperture; some are 4 mm. long and scarcely 2 mm. diameter; but a large number are shorter, smaller, or subimmersed. The corallites at the margin of the colony are in some specimens often unusually long, 5 to 6 mm., with a circular aperture. Corallum moderately porous; surface echinulate, sometimes rather spongy; wall substrate and echinulate.

The species varies considerably in habit. According to Klunzinger, the most frequent form is cespitose, with much divided and little-spreading branches, 6 to 8 cm. high; at other times more arborescent, 15 cm. or more in height, with the branches divided to the base. A flattened depressed form, similar to *M. pyramidalis*, var. *depressa*, also occurs.

Ortmann states (*loc. cit.* p. 152) that a specimen from Singapore, referred by Verrill to *M. arbuscula*, belongs to this species.

Indo-Pacific Ocean: Red Sea, ? Diego Garcia, Maldiv Islands, Ceylon, Mauritius, Singapore, Fiji.

a. Koseir, Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 50.
b. Galles, Ceylon.	Dr. Ondaatje [P.]. 83. 4. 26. 4.
? c. Diego Garcia.	G. C. Bourne, Esq. [P.]. 91. 4. 9. 3.
d. —?	Mantell Coll. 41. 1. 13. 15.
e-g. —?	—? 93. 4. 7. 111 to 113.
h, i. Mauritius.	Purchased. 78. 2. 4. 2 & 5.
j, k. —?	—? 40. 5. 15. 21 & 22.
l. Maldiv Islands.	Purchased. 86. 11. 22. 9.

64. *Madrepora retusa*.

Madrepora retusa, Dana, Zoophytes, p. 462; M.-Edwards & Haime, Coralliaires, t. iii. p. 154; Quelch, 'Challenger' Reef Corals, p. 153; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18.

Madrepora plantaginea, Quelch (*non* Lamarck), 'Challenger' Reef Corals, p. 153.

Corallum small, cespitose, 12 cm. high and broad, consisting of irregular digitiform

branchlets from a common base. Branchlets 6·7 cm. long and 1·2 cm. thick, truncate at the summit. Radial corallites crowded and acervate at the summit of the branchlets, very unequal, some 6 mm. long and others obsolete; majority appressed, tubiform, and slender; lip elongate; exterior smooth; aperture often oblong; star scarcely distinct. Axial corallites difficult to distinguish. (*Dana*.)

The 'Challenger' specimen referred by Quelch to this species agrees with Dana's diagnosis in most respects. The branches are 5 to 6·7 cm. long, 1·5 cm. thick, and quite blunt at the apex. Axial corallites 2·5 mm. thick, 1 to 2·5 mm. exsert; wall rather thick, but tapering; septa in two cycles, the primaries well developed. Radial corallites tubular, spreading irregularly and quite unequal in length and diameter. Prominent corallites 4 to 7 mm. long and 1·5 to 2·3 mm. diameter; aperture usually oblique; wall scarcely thickened; septa not well developed, the outer directive stouter and broader than the others; sometimes a second cycle may be distinguished; the larger corallites frequently bear a single nariform bud; a few very small immersed or subimmersed corallites are scattered between the others; surface strongly echinulate; on the walls of the corallites the echinulations are arranged in close longitudinal rows.

Another specimen from the same locality, referred to *M. plantaginea* by Quelch, may be a variety to this species. The apices of the branches are proliferous and less obtuse than in typical specimens, and the axial corallites, though readily recognizable, are scarcely stouter than some of the radial ones; the more prominent radial corallites have a relatively thick wall with rounded margin.

Pacific Ocean : Fiji, Tahiti.

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| a. Tahiti. | H.M.S. 'Challenger.' 86. 12. 9. 238. |
| b. Tahiti. | H.M.S. 'Challenger.' 86. 12. 9. 250. (= <i>M. plantaginea</i> , Quelch.) |

b. *Branchlets rarely over 6 mm. thick. Corallites tubular to tubo-labellate ; wall usually thin and fragile.*

65. *Madrepora decurrens*.

Heteropora decurrens, Ehrenberg, Corallenth. d. roth. Meeres, p. 111.

Madrepora decurrens, Dana, Zoophytes, p. 488.

The type specimen, which is preserved in the Berlin Museum, consists only of fragments; the habit of the species is probably corymbose. One fragment, 8 cm. high and 10 cm. wide, consists of a cluster of branchlets 5 cm. long and 1 cm. thick at the base (including corallites), most of which are proliferous. Axial corallites 2 to 2·2 mm. diameter and 2 to 3 mm. exsert, wall very porous and fragile; the star consists of six well-developed primary septa, which often meet in the middle line, and of a narrower second cycle. Radial corallites large, thin-walled, elongate tubular, rather distant, at an angle which does not usually exceed 30°; length 4 to 6 mm., diameter 2 mm.; aperture oblique or, in some cases where the inner part of the wall is scarcely developed, the form is tubo-labellate. A few very short and sub-immersed corallites are scattered between the others. On the under surface of the branches

the corallites are shorter, often a little thickened, with a number of small immersed ones interspersed. In some cases the under surface of the branchlets is almost devoid of corallites. The star of the radial corallites consists usually of a narrow primary and a rudimentary second series of septa; but sometimes the directives are rather prominent. Corallum very porous; surface spongy reticulate and strongly echinulate; wall strongly striate (fenestrated at first), apparently not echinulate.

? Indian Ocean.

66. *Madrepora tubigera*.

Madrepora tubigera, Horn, Proc. Acad. Nat. Sci. Philad. 1860, p. 435; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Studer, Mitth. naturf. Ges. Bern, 1880, p. 19; Quelch, 'Challenger' Reef-Corals, p. 161.

? *Madrepora capillaris*, Quelch (*non* Klunzinger), 'Challenger' Reef-Corals, p. 161.

? *Madrepora durvillei*, Fowler, Q. J. M. S. 1886, vol. xxvii. p. 1, pl. i.

The following is Horn's description, which has not been extended by subsequent observers:—

"*M. prostrata*, ramis paulum diffusis, stricte ramosis; ramulis attenuatis (base 3'''), apice acutis. Corallum porosum, caliculo apicale elongato, cylindrico (3-4''' sæpe 5''' longo et $\frac{3}{4}$ ''' lato); lateralibus tubiformibus sæpe labellatis et dimidiatis; stella conspicuâ."

The specimens referred by Quelch to this species have the following characters:—

Corallum extending obliquely or suberect, much branched. Main branch 1.5 cm. thick; branchlets 1.3 to 3.5 cm. long and 3 to 6 mm. thick; some are simple, but the majority are bi- or trifid near the base. The more slender ones consist of a much elongate and often curved tubular corallite 8 to 14 mm. long and 2 mm. thick, which bears a few small fragile and distant buds. The axial corallites of the stouter divisions are also 2 mm. diameter, but are rarely more than 2 or 3 mm. exsert. The radial corallites are usually appressed, labellate, or nariform, passing below into short tubular ones (with the outer part of the wall a little prolonged) and finally immersed; the more prominent ones are 4 mm. long, rather narrow and appressed near the base, but the lip is much broader and recurved, 2 mm. across the widest part; the length and breadth of the corallites varies with the thickness of the branchlet. The tubular ones near the base of the colony are 2 mm. diameter and 1 to 3 mm. long; the immersed ones are a little smaller. In all the radial corallites, excepting perhaps near the base of the stouter divisions, the wall is very thin and fragile. In the axial corallites the star consists of two well-developed cycles of septa; in the radial corallites the directive septa often fuse together in the middle line; the other primaries are moderately developed, but the second cycle is usually not noticeable. Corallum extremely porous and reticulate in section; surface reticulate and echinulate. The wall of the elongate tubular corallites is costulate; the costæ become echinulate in the lower part of the corallite. The others are costulate and echinulate, but the striations become lost near the base of the corallum.

The fragments referred by Quelch to *M. capillaris*, Klz., probably do not belong to that

species. They consist of marginal fragments of a colony of *M. tubigera*, as was suspected by Quelch himself. The elongate tubular corallites are here more numerous and there is an absence of the thicker tapering branchlets frequent in the larger specimens. The species of which Fowler gives an account of the structure under the name *M. durvillei*, Ed. & H., is the same as that recorded as *M. capillaris* by Quelch.

The Coralhaven specimen has a number of the lateral corallites elongate and tubular, with a round or oblique aperture.

Singapore, Banda, Louisiade Archipelago.

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| <i>a, b.</i> Banda. | H.M.S. 'Challenger.' 86. 12. 9. 273 & 241. |
| ? <i>c.</i> Banda. | H.M.S. 'Challenger.' 86. 12. 9. 240. (= <i>M. capillaris</i> , Quelch.) |
| <i>d.</i> Coralhaven, Louisiade Archipelago. | J. Macgillivray, Esq. [P.]. 51. 9. 29. 40. |

67. *Madrepora capillaris*.

Madrepora capillaris, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 29, pl. iii. fig. 4, pl. iv. fig. 13, pl. ix. fig. 23 (*non* Quelch, 'Challenger' Reef-Corals, p. 161).

Corallum arborescent; stem 20 cm. long, 15 to 20 mm. thick. Main branches clothed with very numerous, spreading, very slender, elongate, often divided, tubular branchlets, which are scarcely thicker near the base of the corallum than above; they vary from 1 to 6 cm. in length and from 3 to 4 mm. in thickness, their apices being about 1 cm. apart. Axial corallites 2.5 to 3 mm. broad, usually bearing lateral buds to within 2 or 3 mm. of the apex; some of the shorter twigs consist of simple, often arcuate corallites, spreading almost at right angles, and broader at the apex than at the base. Radial corallites of the branchlets 3 to 4 mm. long, 2 to 3 mm. broad, dimidiate, open nariform, very spreading, and distant; those of the stems and main branches short, appressed, verruciform, or with a sharply defined ring-shaped border, rarely completely immersed. Corallum dense, but fragile on account of the long slender branchlets; surface dense and striate, with very small echinulations and granules; wall strongly striate, not echinulate.

Red Sea; ? Great-Barrier Reef.

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| ? <i>a.</i> Port Denison. | Saville-Kent Coll. 92. 6. 8. 280. |
| ? <i>b.</i> Rocky Island. | Saville-Kent Coll. 92. 6. 8. 276. (Young.) |

68. *Madrepora diffusa*.

Madrepora diffusa, Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Quelch, 'Challenger' Reef-Corals, p. 161.

Corallum low, arborescent, much branched, recalling the habit of *M. formosa*; branchlets divaricate, gradually tapering to an acute apex; about 8 mm. thick and 5 to 7.5 cm. long.

Radial corallites broad, tubo-nariform, short, widely open, wall striato-echinulate; septa in a single narrow cycle, the inner directive broadest. Axial corallites exsert, but scarcely larger than the radial ones. Corallum porous, reticulate in section; surface reticulate or striate and echinulate.

In the 'Challenger' specimen the small branchlets are seen to be produced from elongate tubular corallites, 2 mm. diameter near the apex, the terminal 4 to 6 mm. usually without buds. Radial corallites spreading, nariform or tubular, with the inner part of the wall scarcely free, 1.5 to 2 mm. wide, the outer part of the wall rarely 2 mm. long; the aperture is wide and circular. Towards the base of the branches many of the corallites have a ring-shaped border, and in them a second cycle of septa is more or less completely represented. The species is closely related to *M. tubigera*.

East Indies: Kingsmill Islands, Banda.

a. Banda.

H.M.S. 'Challenger.' 86. 12. 9. 269.

69. *Madrepora dilatata*.

Madrepora tenuis, Ortmann (*non* Dana), Zool. JB. 1888, Bd. iii. p. 152.

Corallum consisting of a bushy clump 10 cm. high and 16 cm. broad. Branches much divided from the base; distal divisions 2 to 3 cm. long and 4 to 5 mm. thick, often forked at the apex. Axial corallites 2 to 2.5 mm. thick, not over 2 mm. exsert: wall very porous and not much thickened. Radial corallites rather distant, elongate, appressed, tubular, with the distal part dilated and the aperture very oblique; the form is dimidiate, length 4 to 5 mm., diameter 2 mm., becoming short, and finally immersed below. Star well developed, but the septa are delicate. Corallum very porous; surface spongy and strongly echinulate; wall very porous and striato-reticulate; the striae are well marked, rather distant, and finely dentate.

This species approaches *M. tenuis*, Dana, but differs from the specimens I have referred to that species in the stouter axial corallites, the more elongate and dilated radial corallites with very oblique aperture, and the better developed star.

Pacific Ocean: Tongatabu (*Strassburg Museum*).

70. *Madrepora dendrum*. (Plate XXXIII. figs. A, B.)

Madrepora dendrum, B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 452.

Corallum "arborescent subcespitose; stem solid, strong; surface finely echinulato-striate, bearing curved, simple or proliferous, gradually tapering branchlets 2.5 cm. long and 3 mm. thick, with compressed nariform calicles, tending to form into rows showing two very long (broad) septa; apical calicles 1 mm., exsert, stem distinct; under surface shows branches sinuously curved, with spreading margin, not coalescing, with few immersed corallites." (*B.-Smith*.)

The fragments on which the species is founded are too much broken to admit of a proper description being given; but the broad flattened branches (1.5 cm. diameter) with a few irregularly scattered corallites on the under surface and short spiciform branchlets above appear to indicate a new species. Bassett-Smith records the habitat as "Macclesfield and Tizard Banks." All three specimens are labelled "Macclesfield Bank," and two are so very small that it is useless to try and identify the species; they do not agree with any part of the larger specimen preserved.

During the more recent exploration of the Macclesfield Bank by H.M.S. 'Penguin' a number of fragments which possibly belong to this species were again obtained. All are evidently only the marginal portions of a colony, and do not show the flattened branches of the more central divisions, but agree better with the smaller fragments of the original collection. The under surface is provided with distant appressed tubular corallites, usually with the inner part of the wall scarcely free. On the upper surface certain corallites give rise to suberect twigs about 1.5 cm. long and 4 mm. diameter at the base, the apices being about 1 cm. apart, simple or proliferous. Axial corallites cylindrical, scarcely 2 mm. diameter, 1 to 4 mm. exsert; wall thin; septa well developed, particularly the primaries, which sometimes meet in the middle line. A few of the marginal axial corallites are 2.7 mm. diameter and scarcely exsert. The radial corallites are appressed, tubular, with the inner part of the wall only free in elongate individuals; length 3 to 5 mm., diameter 1.5 mm.; wall striato-echinulate; primary septa narrow, but the directives distinctly broader, the second cycle usually wanting. This form has more elongate and more distant corallites than the type, and may not belong to the same species. It appears nearly related to *M. dilatata*.

China Sea: Macclesfield Bank, 20 to 27 fathoms.

<i>a.</i> Macclesfield Bank.	H.M.S. 'Rambler.'	89. 9. 24. 54.	} Types.
<i>b-d.</i> Macclesfield Bank.	H.M.S. 'Rambler.'	89. 9. 24. 13 & 15 ;	
		93. 4. 7. 167.	
<i>e-g.</i> Macclesfield Bank, 13 fath.	H.M.S. 'Penguin.'	92. 10. 17. 75 to 77.	
<i>h-j.</i> Macclesfield Bank, 18 to 28 fath.	H.M.S. 'Penguin.'	92. 10. 17. 28 to 30.	

71. *Madrepora nana*.

Madrepora nana, Studer, MB. Akad. Wiss. Berlin, 1878, p. 533, pl. ii. fig. 6.

Corallum small, consisting of a few little-divided, slender, gradually tapering branches, not over 2 cm. long and 4 mm. thick, which arise from an incrusting base. Axial corallites cylindrical, 1 mm. broad and 1 mm. exsert. Radial corallites rather distant, appressed, nariform or tubo-nariform, with circular aperture, 0.5 mm. long and 0.7 mm. broad; star distinct, the directive septa rather more prominent than the others. Cœnenchyma porous; surface finely striate.

The small size of the colony renders it possible that the characters of the species are not completely developed in the type specimen.

Pacific Ocean: Matuku, Fiji Archipelago (*Berlin Museum*).

72. *Madrepora tenuis*.

Madrepora tenuis, Dana, Zoophytes, p. 451; M.-Edwards and Haime, Coralliaires, t. iii. p. 152; Quelch, 'Challenger' Reef-Corals, p. 157; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 152; ? B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 453).

Corallum cespitose, rounded, sparingly spreading; branchlets very slender, scarcely 4 mm. thick, 7.5 cm. long, subterete and proliferous. Axial corallites 1.3 mm. broad, a little prominent. Radial corallites appressed, tubiform, irregular, about 1.3 mm. broad and 3 mm. long, attached not quite to the summits; margin fragile, aperture circular; exterior neatly striate and finely scabrous; star indistinct, the directive septa a little prominent. (*Dana*.)

The specimens from Samboangan referred by Quelch to this species agree fairly well with the above description. The habit recalls that of *M. rosacea*, Esp., but the branches are rather stouter and more divided, and the corallites much shorter, with broadly striate wall. Axial corallites cylindrical, 1.5 mm. diameter, with thin wall, a little exsert. Radial corallites ascending tubular, with thin wall and circular aperture; a little unequal in length and diameter, some bear buds; diameter 1 to 1.5 mm. and 2 to 3.5 mm. long, becoming shorter and more irregular below. Star moderately prominent, composed usually of six delicate septa of which the directives are the broadest. Corallum very porous; surface and wall striato-echinulate.

East Indies, Samboangan, ? Tizard Bank, Great-Barrier Reef.

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| <i>a-c.</i> Samboangan. | H.M.S. 'Challenger.' 86. 12. 9. 242 & 411; 92. 10. 16. 31. |
| <i>d.</i> Wreck Bay, Great-Barrier Reef. | J. B. Jukes, Esq. [P.]. 46. 7. 30. 9. (Young colony.) |
| <i>? e.</i> Tizard Bank. | H.M.S. 'Rambler.' 89. 9. 24. 96. (= <i>M. tenuis</i> ?, B.-Sm.) |

73. *Madrepora africana*. (Plate XXXV. fig. B.)

Corallum small, cespitose, resembling *M. tubicinaria* in habit; height 5.5 cm., diameter 9 or 10 cm. Branches simple or divided near the base and irregular in outline, owing to inequalities in the size of the radial corallites; length 3 to 3.5 cm., diameter 7 mm. near the base, but more near the apex owing to the presence of stout, prominent, and often proliferous corallites in that position. Axial corallites cylindrical, little prominent, 3 to 3.5 mm. diameter, aperture 1.5 mm., wall very porous; septa moderately developed, the primaries equal, the second cycle very narrow. Radial corallites appressed nariform to tubiform, rather small and crowded near the apex, but becoming more distant and of much larger diameter a little lower down; length 2 to 5 or even 6 mm., diameter 1.3 to 2.5 mm. Towards the base of the branchlets one or more elongate ascending tubular corallites occur, which may be 10 mm. long and 3 mm. diameter, with or without a few small buds. The wall of the radial corallites is usually quite thin and even in the long tubular corallites is not over 0.5 mm. thick. The arrangement of the radial corallites is very irregular, and on the basal parts most are immersed or subimmersed. In the prominent corallites usually only the directive septa are recognizable, and the outer one is usually broader than the other. In the

immersed corallites the directive septa may be well developed, the other primaries of moderate breadth, and a more or less complete second cycle then occurs. Corallum very porous; surface reticulate and echinulate; wall fenestrated, echinulate at the base.

The type specimen was collected by Dr. Krauss on the coast of South Africa. The locality is entered in the register as "Cape of Good Hope," but I think it probable that the specimen came from the South-east Coast and not from Cape Colony.

Southern part of the Indian Ocean, Ceylon, and ? Solomon Islands.

<i>a.</i> South Africa.	Dr. Krauss [C.].	40. 9. 30. 9. (Type.)
? <i>b.</i> Sta. Anna Isl., Solomon Islands.	Dr. Guppy [P.].	84. 12. 11. 28. (Young colony.)
<i>c, d.</i> Ceylon.	Madras Museum.	90. 6. 28. 2 & 7. (Var.)

74. *Madrepora rosacea*.

Madrepora rosacea, Esper, Pflanzenth. Th. i. p. 115, *Madr.* pl. xv. fig. 2, ? 3 & 4; Studer, MB. Akad. Wiss. Berlin, 1878, p. 530; Quelch, 'Challenger' Reef Corals, p. 157.

Corallum cespitose, about 9 cm. high and 10 to 14 cm. broad, consisting of crowded forked branches which are separated quite to the base. Distal divisions 3 to 3.5 cm. long and 5 mm. diameter at the base, but more above, owing to the greater prominence of the corallites. Axial corallites cylindrical, 2 mm. diameter, scarcely exsert; the star consists of 6 septa only, the directives somewhat broader than the others. Radial corallites tubonariform or tubular, the inner part of the wall absent at first and rarely as prominent as the outer, excepting in such individuals as become converted into axial corallites and bear buds; length 3 to 5 mm., but some scarcely free, others with an elongate tip and often with immersed or subimmersed cells between, diameter 1.3 mm., angle 20° to 45°; the star consists of 6 septa, the directives often nearly meet, but the other four are quite narrow. Towards the base of the branchlets nearly all the corallites become subimmersed and have an indistinct star. Corallum dense; surface coarsely granular; wall finely striate and bluntly echinulate.

East Indian Archipelago.

<i>a, b.</i> Samboangan.	H.M.S. 'Challenger.'	86. 12. 9. 288 & 232.
<i>c.</i> Ternate.	H.M.S. 'Challenger.'	86. 12. 9. 408.

75. *Madrepora disticha*. (Plate XXXIII. fig. D.)

Corallum cespitose or subcorymbose, consisting of slender, crowded, and repeatedly-forked branches from a common base; height 9 cm., diameter 12 cm. Branches 7 cm. long and 8 mm. diameter at the base; distal divisions 2 to 3.8 cm. long, little divergent; diameter 6 mm. below, where the corallites are short, but more near the apex, which is often proliferous; apices about 1.5 cm. apart. Axial corallites cylindrical, 2 to 2.5 mm. diameter and often 3 mm. exsert. Radial corallites tubular, those near the apex of a branch are a little spreading and unequal in size; some are distinctly compressed; length 2 to 3 mm., diameter 1

to 2 mm.; the stouter ones bear buds. The wall is moderately thick excepting in its inner part, which is thin and often not quite so prominent, giving an elliptical aperture. Usually at a point 1 to 1.5 cm. below the apex of a branch the corallites become shorter and verruciform, but scarcely any are completely immersed, even at the base of the branches. Star distinct, but not very broad; it consists of 12 septa, with the outer directive usually broader and stouter than the others. Corallum dense; surface and wall closely and finely echinulate; margin distinctly rounded in all except the youngest corallites.

Indian Ocean: Diego Garcia.

a b, ? c. Diego Garcia.

G. C. Bourne, Esq. [P.]. 91. 4. 9. 5, 9 & 10. (Types.)

B. Corallum corymbose, more rarely cespitose: corallites elongate, with dense wall and often acuminate apex.

76. *Madrepora appressa*.

Heteropora appressa, Ehrenberg, Corallenth. d. roth. Meeres, p. 109.

Madrepora appressa, Studer, Mitth. naturf. Ges. Bern, 1880, p. 22 (*non* Dana, M.-Edwards & Haime, &c.).

Corallum corymbose (?), the under surface of the branches horizontal and fused into flattened plates, with a few thick conical corallites below, most of which are lateral, and a few immersed ones scattered over the general surface. Branchlets on the upper surface about 4 to 6 cm. long and 1 to 1.5 cm. thick at the base. Axial corallites 2 to 2.5 mm. diameter, with rounded margin and small aperture. Radial corallites elongate and appressed with rather thick curved wall, up to 8 mm. in length and 2 mm. thick, the more elongate ones have a slit-like aperture and are proliferous: all are very irregularly placed. The usual form is hooked labellate, with a thick blunt and frequently incurved apex; those below are short or immersed; aperture 1 mm.; 6 primary septa, prominent. Corallum moderately porous, but firm; surface dense and echinulate, or tabulato-echinulate with elongate pits between; wall dense and echinulate, not striate.

This species differs from the form which I believed to represent Dana's *M. appressa* in its more robust habit, and particularly in the longer and stouter radial corallites with an elongate, thick and blunt apex. It may, however, be only an individual variation, and I have not seen elsewhere any specimen which agrees with it completely.

Habitat of the type specimen (*Berlin Museum*) not recorded.

? *a.* Evans Bank, 15 fath., Arafura Sea.

H.M.S. 'Penguin.' 92. 4. 5. 3.

77. *Madrepora assimilis*. (Plate XX. fig. A.)

Madrepora appressa, Dana (*non* Ehrenberg), Zoophytes, p. 457, pl. xxxiv. fig. 5, pl. xxxi. fig. 8; ? Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; ? Studer, Mitth. naturf. Ges. Bern, 1880, p. 22; Quelch, 'Challenger' Reef Corals, p. 163; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 12.

Madrepora appersa, M.-Edwards & Haime, Corailliars, t. iii. p. 156; ?Studer, Mitth. naturf. Ges. Bern, 1880, p. 20.*

Madrepora assimilis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 452.

Corallum prostrate; horizontal branches coalescing into a plate which is nearly entire, flattened and naked below; above, branchlets erect, crowded, spiciform, nearly terete, 6·2 to 7·5 cm. long and 6 mm. thick. Axial corallites a little prominent; the radial ones crowded and equal, 3 mm. long, appressed and subimbricate, rostrato-nariform, very minutely striate; star very distinct. (*Dana*.)

The 'Challenger' specimen referred to *M. appressa* appears to agree with Dana's species, but is not that recorded by Ehrenberg; the following is a short description of it:—Corallum corymbose, not pedicellate, flattened above; the branches horizontal, coalescing into a plate with numerous irregular corallites with pore-like aperture; length 5 mm., diameter 1·5 mm., usually applied to the surface throughout the whole length. Branchlets on the upper surface ascending, subterete, 6 to 7 cm. long and 6 to 8 mm. thick; apices about 1·4 cm. apart. Axial corallites 2 mm. diameter, and about 1 mm. exsert. Radial corallites ascending and crowded, subequal, beaked-nariform or compressed-tubular, with an oblique aperture; length 4 mm., diameter 1·2 by 1·4 to 1·8 mm., those below are short and a little dilated, becoming finally immersed. Star very well developed, but a second cycle of septa is only found in the shorter radial corallites towards the base of the branchlets, rarely in the axial corallites. Corallum moderately porous, surface compact and echinulate in linear series; wall striate and echinulate near the base.

East Indies.

a. Amboina.	H.M.S. 'Challenger.'	85. 2. 1. 7.	(Type= <i>M. appressa</i> , Quelch.)
b. Amboina.	H.M.S. 'Penguin.'	92. 4. 5. 1.	
? c. Solomon Islands.	Dr. Guppy [C.].	84. 12. 11. 20.	

78. *Madrepora cymbicyathus*.

Madrepora cerealis, Ortmann (*non Dana*), Zool. JB. 1888, Bd. iii. p. 152.

Corallum corymbose, 12 cm. high and 24 cm. broad. Middle branches 5 to 5·5 cm. long, 1·2 cm. thick at the base, somewhat angular below, centres about 1·5 cm. apart. Marginal branches oblique, with short horizontal outer divisions and numerous tubular corallites. The central branches are simple or divided near the base into three or four subparallel branchlets, rarely proliferous excepting near the margin of the corallum. Axial corallites 2·5 mm. diameter, 2 mm. exsert; wall rather thick and dense, margin a little rounded. Radial corallites elongate, spreading, and rather crowded, often arranged in rows near the apex of a branch, 3 to 4 mm. long and 2 mm. thick. They are frequently tubular with a narrow slit in the inner side, extending nearly the whole length of the corallites; in other cases where the slit is wider they are shaped like a canoe. The wall is a little thickened, with the margin rounded. The corallites on the distal parts of the branches are subequal, with a few scarcely apparent immersed ones between; nearer the base they are hooked-nariform, more appressed, with immersed corallites between. A few proliferous corallites occur on some of the branches,

which are 7 mm. long and 2.5 mm. thick, with a rosette of bud corallites at the base. The septa are not well-developed in the radial corallites, usually only the directives are prominent. Corallum not very porous; surface echinulate and spongy in parts; wall substriate and echinulate.

A specimen from Samoa has rather shorter corallites, most of which are canoe-shaped.

Pacific Ocean : Fiji, Samoa (*Strassburg Museum*).

79. *Madrepora alliomorpha*.

? *Madrepora secale*, Studer, Mitth. naturf. Ges. Bern, 1880, p. 22 (*non* Ortmann, Zool. JB. 1889, Bd. iv. p. 510).

? *Madrepora appressa*, Ortmann (*non* Ehrenberg), Zool. JB. 1889, Bd. iv. p. 509.

Corallum broad, corymbiform, and short pedicellate, 18 cm. high and 45 cm. broad. Under surface oblique, obconical, consisting of an intricate network of branches with immersed corallites and stunted branchlets exteriorly, pressed almost into the general plane, bearing numerous contorted tubular corallites applied to the twigs throughout the whole length. On the upper surface the branches are about 1 cm. diameter, divided near the base into clusters of three or more branchlets, some of which are proliferous. Axial corallites 2 mm. diameter or a little over, 1 to 1.5 mm. exsert; wall thick, margin slightly rounded. Radial corallites in the upper parts a little spreading, subtubular or boat-shaped, sometimes with the inner part of the wall short; the outer margin is curved, the apex rounded, and the aperture is generally not quite at the apex but opens inwards. At a point from 2 to 2.5 cm. from the apex the corallites are more appressed, and the outer margin is then straight; they subsequently become gradually shorter and at the base immersed; length of those in the distal parts 3 to 4 mm., diameter 1.2 to 1.5 mm.; wall firm and dense. Primary septa well-developed in the radial corallites, with sometimes indications of a second cycle; in those corallites which are boat-shaped the directive septa are very broad. Corallum rather dense, scarcely reticulate in section; surface dense and echinulate, but reticulate in patches; wall finely echinulate.

Singapore (*Jagor*). Berlin Museum.

80. *Madrepora secale*.

Madrepora plantaginea, Dana (*non* Lamarck), Zoophytes, p. 459.

? *Madrepora echidnaea*, Dana (*non* Lamarck), Zoophytes, p. 458, pl. xxxv. fig. 3, pl. xxxi. fig. 9 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 152).

Madrepora appressa, var., Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; *ibid.* Dana's Corals and Coral Islands, Appendix, 1875 ed. p. 333; ? Ortmann, Zool. JB. 1889, Bd. iv. p. 509.

Madrepora secale, Studer, MB. Akad. Wiss. Berlin, 1878, p. 530; ? *ibid.* Mitth. naturf. Ges. Bern, 1880, p. 22; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18 (*non* Quelch, 'Challenger' Reef Corals, p. 163; *non* Ortmann, Zool. JB. 1889, Bd. iv. p. 509).

Madrepora globiceps, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454.

Madrepora acervata, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454.

Corallum very broad cespitose (corymbose?), slightly convex; branches horizontal, coalescing into a flattened lamina nearly entire, naked below, and interrupted by an occasional break; above branchlets spiciform, 8 to 12 mm. thick, and 5 to 6.3 cm. long, often proliferous and irregular. Axial corallites 2 to 3 mm. broad and little prominent. Radial corallites tubiform appressed, very unequal, often 4 mm. long, and 1.5 mm. broad, stout, with an obtuse lip, exterior finely striate, smooth; aperture scarcely elliptical; star quite distinct. (*Dana*.)

Unfortunately it does not at present appear clear which specimens in the Berlin Museum were referred by Studer to *M. secale*. Those which are now labelled *M. secale*, but not in Studer's handwriting, do not all belong to our species, and none of them appear to me to agree with Dana's description of *M. plantaginea*, which, in the absence of a diagnosis by Studer, must be held as the diagnosis of *M. secale*.

The specimens which I have referred to this species have the following characters:—Corallum corymbose, up to 48 cm. wide and 12 cm. high, not pedicellate. Main branches horizontal or oblique, more or less confluent, but scarcely fused into a plate. Under surface provided with short, blunt, oblique twigs, covered with verruciform and immersed corallites. Branches on the upper surface erect, 5 to 7.5 cm. long, and 8 to 12 mm. thick, simple or divided, usually proliferous, apices about 2 cm. apart. Axial corallites 2.5 to 3 mm. diameter, subcylindrical, 1 to 4 mm. exsert, aperture variable in size, sometimes 1.5 mm. Radial corallites appressed, crowded, and very unequal, not usually compressed, chiefly rostrate, dimidiate or rostrate, or tubo-nariform; wall usually thickened, outer part often convex; those below are hemicytoid and finally immersed; diameter 1.5 to 2.5 mm., length 3 to 6 mm. The star consists of 6 well-developed septa, of which the directives are very broad. Corallum dense; surface reticulate; wall not striate, clothed with fine, simple echinulations. In two of the specimens, numerous examples of *Pecten madreporarum*, Petit, occur near the base of the branchlets, and a special plate of coral is secreted around each valve of the shell. The radial corallites are always appressed, but the outer part of the wall is more elongate in some specimens than in others. The species has a similar habit to *M. concinna*, but differs in the angle of the corallites, and the less complete inner part of the wall. The form of the corallites in Dana's specimens is not given clearly. A specimen in the Berlin Museum labelled *M. secale* does not agree so well with Dana's description as those described above, but may be one of the specimens studied by Studer. I have described it as new under the name *M. alliomorpha*.

Indo-Pacific Ocean: Ceylon, East Indies, Singapore, China.

<i>a</i> — ?	Purchased.	44. 6. 10. 2.	
<i>b</i> . — ?	— ?	93. 4. 7. 105.	
<i>c</i> . — ?	Purchased.	41. 1. 13. 16.	
? <i>d</i> . Singapore.	Purchased.	78. 6. 6. 4.	
? <i>e</i> . China (probably S.).	Fisheries Exhib.	84. 2. 26. 21.	
? <i>f, g</i> . Ceylon.	Haeckel Coll.	92. 12. 5. 20 & 28.	
<i>h</i> . Tizard Bank.	H.M.S. 'Rambler.'	89. 9. 24. 103.	(= <i>M. globiceps</i> , B.-Sm.)
<i>i</i> . Tizard Bank.	H.M.S. 'Rambler.'	89. 9. 24. 108.	(= <i>M. acervata</i> , B.-Sm.)

81. *Madrepora tizardi*. (Plate XI. figs. C, D.)

Madrepora nasuta, Bassett-Smith (*non* Dana), Ann. Mag. N. H. 1890, vol. vi. p. 453.

Madrepora effusa, Bassett-Smith (*non* Dana), Ann. Mag. N. H. 1890, vol. vi. p. 454.

? *Madrepora plantiginea*, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 453.

? *Madrepora valida*, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 453.

? *Madrepora corymbosa*, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454.

Madrepora tizardi, Brook, Ann. Mag. N. H. 1892, vol. x. p. 464.

Corallum corymbose, a little concave above, 10 cm. high and 28 cm. wide. Under surface oblique, reticulate or almost solid, with short stunted twigs in the general plane; lower surface almost naked if nearly solid, but otherwise provided with a few scattered verruciform and immersed corallites, most of which are lateral. Branches 1·2 cm. diameter at the base. Branchlets erect and relatively slender and elongate in some specimens, but stouter and more stunted in others. Apices about 1·2 cm. apart. Length in the elongate form 4 cm., diameter 6 to 8 mm. at the base; in the stunted form the length is about 3 cm. and the diameter 1 cm. or slightly over. Axial corallites cylindrical, 2 mm. diameter or a little over, 1 to 2 mm. exsert; wall dense, margin sometimes slightly rounded, aperture very small. Radial corallites ascending and rather distant, dimidiate, gutter-shaped or hooked-nariform, with the outer margin curved, those below are dilated verruciform, with the aperture opening inwards; these gradually become less prominent, and all are immersed at the base of the branchlets. The length is very variable, usually 2·7 to 4 mm., diameter about 1·6 mm., but all the more prominent ones are distinctly compressed. At intervals elongate, compressed, tubular corallites with oblique aperture occur, which indicate new outgrowths; these are 5 to 8 mm. long, and 1·5 to 2 mm. diameter. At a later stage when such corallites form short twigs with small corallites at the base, the axial corallite frequently has the terminal 6 or 7 mm. free from buds. The prominent corallites are frequently arranged in irregular longitudinal rows, with immersed or subimmersed corallites between. The wall is a little thickened and very dense, surface closely echinulate. The star consists of 6 or 12 septa, all of which are usually narrow with the exception of the outer directive, which, in many cases, especially in the hooked-nariform corallites, is very broad.

Var. *bæocyathus*.

Corallum broad, shallow, vasiform, the main branches becoming fused into a solid plate, sometimes 36 cm. long, 24 cm. broad, and about 3 cm. thick, with small, scattered, sub-immersed corallites on the under surface. Branchlets on the upper surface short and stout, rarely 2 cm. long, and about 8 mm. thick. Axial corallites scarcely more prominent than the radial ones which surround them, and of similar diameter, but with circular or only slightly elliptical aperture. Radial corallites tubular, tubo-nariform, or dimidiate, with a more or less tapered apex, and with many subimmersed or short labellate ones between; diameter of the more prominent corallites 1 to 1·6 mm., scarcely compressed, length rarely over 3 mm.

China Sea: Tizard and Macclesfield Banks.

a. Tizard Bank, 5 fath.	H.M.S. 'Rambler.' 89. 9. 24. 115.	} Types.
	(= <i>M. nasuta</i> , B.-Smith.)	
b. Tizard Bank, 5 fath.	H.M.S. 'Rambler.' 89. 9. 24. 114.	
	(= <i>M. effusa</i> , B.-Smith.)	
? c. Tizard Bank, 5 fath.	H.M.S. 'Rambler.' 89. 9. 24. 97.	(= <i>M. valida</i> , B.-Smith.)
? d. Tizard Bank, 6 fath.	H.M.S. 'Rambler.' 89. 9. 24. 111.	(= <i>M. plantiginea</i> , B.-Smith.)
? e. Tizard Bank.	H.M.S. 'Rambler.' 89. 9. 24. 106.	(= <i>M. corymbosa</i> , B.-Smith.)
f. Tizard Bank.	H.M.S. 'Rambler.' 93. 4. 7. 155.	
g. Macclesfield Bank.	H.M.S. 'Rambler.' 89. 9. 24. 71.	
h-r. Macclesfield Bank, 13 fath.	H.M.S. 'Penguin.' 92. 10. 17. 44 to 54.	

Var. *bæocyathus*.

a-e. Macclesfield Bank, 13 fath.	H.M.S. 'Penguin.' 92. 10. 17. 55 to 59.
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82. *Madrepora quelchi*. (Plate XXXII. figs. D, E.)

Madrepora effusa, Quelch (*non* Dana), 'Challenger' Reef Corals, p. 154.

Corallum half-vasiform from a lateral stalk, 24 cm. wide and 12 cm. high. Branches oblique, 1 cm. diameter, a little flattened on the under surface, with scattered, appressed, tubular corallites below, and a few short lateral twigs; the proximal parts are more or less coalescent, but the distal parts are free. The branchlets on the upper surface are distant, erect, and tapering; length 4 to 8 cm., diameter 8 to 11 cm.; apices about 2 cm. apart. Axial corallites cylindrical, 2 to 2.5 cm. diameter, and 2 to 3 mm. exsert; the septa are in two cycles, the primary series being subequal and not very prominent. Radial corallites chiefly elongate, compressed, and spreading tubular; the aperture is oblique, or more frequently a narrow slit extends for a variable distance along the upper (inner) part of the wall, sometimes quite to the base. In passing downwards the form becomes tubo-labellate, spout-shaped, and finally verruciform towards the base of the main divisions. On the distal parts of the branches the more prominent corallites are arranged in more or less regular longitudinal rows, with a few immersed corallites between; length 2.5 to 6 mm., average 4 mm., diameter 2 mm.; the wall is thickened, dense, and closely striato-echinulate; the margin is distinctly rounded. The primary septa are well developed, the directives broadest; the second cycle is more or less fully represented, but is not complete in the immersed corallites.

Var. *paradoxa*. (Plate XXXII. fig. D.)

Branches on the upper surface erect, 11 cm. long, and divided into three or more parallel divisions, in which the axial corallites are scarcely prominent. The tubular radial corallites are similar to those of the type, but the margin is scarcely rounded, and the aperture is more rarely elongate. On the lower parts of the branchlets swollen hemicotyloid and immersed corallites occur in place of verruciform ones. The immersed corallites are numerous, about 1 mm. diameter, and exhibit a prominent star in which two or more of the

primary septa become confluent and form a solid axial rod, which is often rounded and nodular at its apex. This form may prove to be a distinct species.

Amboina; Solomon Islands.

a. Amboina.

H.M.S. 'Challenger.' 86. 12. 9. 287.

(Type=*M. effusa*, Quelch.)

b. Treasury Island, Solomon Islands.

Dr. Guppy [P.]. 84. 12. 11. 21. (Var. *paradoxa*.)

83. *Madrepora cerealis*.

? *Madrepora muricata*, var., Esper. Pflanzenth. Fortsetz. Th. i. pl. liii.

Madrepora cerealis, Dana, Zoophytes, p. 460, pl. xxxv. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 151; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Studer, Mitth. naturf. Ges. Bern, 1880, p. 22; Quelch, 'Challenger' Reef Corals, p. 153; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 13 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 152).

Madrepora secale, Quelch (*non* Studer), 'Challenger' Reef Corals, p. 163.

Corallum broad cespitose, somewhat convex; not complanate below, but this may be owing to the type not being a full-grown specimen; it measures 12.5 cm. in height and 15 cm. in diameter. Branchlets numerous, erect, spiciform, 6 to 8 mm. thick and 5 mm. long, not terete, very unevenly covered with corallites, some of which are long and proliferous. Axial corallites 1.5 mm. diameter, a little prominent. Radial corallites appressed, subtubular, unequal, 2 to 3 mm. long, subrostrate, exterior smooth; aperture elliptical; star very short and imperfectly distinct; the directive septa are a little prominent. (*Dana*.)

A specimen in the collection, from Wreck Bay, agrees almost exactly with Dana's figure. The axial corallites are cylindrical, 2 mm. diameter, and have a rather dense wall. Radial corallites tubular, with subimmersed to labellate or half-tubular ones between. The more prominent tubular corallites often have the inner part of the wall as prominent as the outer, and are frequently arranged in irregular longitudinal rows; length 2 to 4 mm., diameter 1.2 to 1.8 mm. The axial corallites have only 6 septa, and the directives are rather broader than the others. In the tubular radial corallites the directive septa are broad and subequal, but are situated deep down; the other primary septa are either absent or very narrow. In immersed and subimmersed corallites the septa are better developed. In a specimen from Mauritius the tubular radial corallites have rarely a circular aperture, and the axial corallites show indications of a second cycle of septa. In the specimens which form part of Mr. Saville-Kent's collection the aperture of the radial corallites is still more oblique and often slit-like.

The 'Challenger' specimens referred by Quelch to *M. secale* and *M. cerealis* appear to me to belong to one species, but differ in several points from typical *M. cerealis*. The specimen referred to *M. secale* is a small corymbose clump in which the marginal branches extend a little obliquely, but are not fused together.

The other specimen is considerably larger and a fusion takes place between the main branches, which are prostrate and subcomplanate below. The under surface is provided with short stunted branchlets in the general plane, and with appressed, tubular, or verruciform corallites. There is here a general resemblance to *M. assimilis*, but on the upper surface the

corallites are longer, quite unequal in length, and more spreading, so as to give the branchlets an apparent greater diameter. They differ from Dana's description in one or two points. The prominent radial corallites are all compressed, 3 to 5 mm. long and 1.5 mm. thick, but a few are longer, thicker, and bear a few small buds; the form is usually narrow boat-shaped or tubo-labellate; the outer part of the wall is always thicker than the inner, and in the stouter ones is considerably thickened, the aperture being oblique and slit-like. Between the prominent corallites short or subimmersed ones occur to near the apex of the branchlets; in the basal parts all become short, appressed, tubular, with a moderately thick wall and rounded margin, with immersed cells interspersed. Corallum porous, finely reticulate in section; surface striato-reticulate or spongy in parts; wall firm, with the appearance of porcelain, very finely striato-reticulate. Axial corallites cylindrical, 2 mm. diameter, 1 to 2 mm. exsert, wall a little thickened; the star consists of 6 subequal septa, with sometimes indications of a second cycle. In the prominent radial corallites usually only the two directive septa are prominent, but nearer the base the star is better developed and sometimes a rudimentary second cycle of septa may be distinguished.

Indo-Pacific Ocean: Mauritius, Seychelles, East Indies, Sulu Sea, Singapore, Amboina, Ternate, Ponapé, Samoa, Great-Barrier Reef, Fiji, Tongatabu.

a. Wreck Bay, Great-Barrier Reef.	J. B. Jukes, Esq. [P.]. 46. 7. 30. 1.
b. Wreck Bay, Great-Barrier Reef.	J. B. Jukes, Esq. [P.]. 46. 7. 30. 6. (Young in-crusting colony.)
c. Port Denison.	Saville-Kent Coll. 92. 6. 8. 197.
d. Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 198.
e. Rocky Island.	Saville-Kent Coll. 92. 6. 8. 302.
f, g. Mauritius.	Purchased. 78. 2. 4. 1 & 4.
h. Ternate.	H.M.S. 'Challenger.' 85. 2. 1. 3. (= <i>M. secale</i> , Quelch.)
i. Amboina.	H.M.S. 'Challenger.' 85. 2. 1. 1. (= <i>M. cerealis</i> , Quelch.)
j. Seychelles.	H.M.S. 'Alert.' 82. 10. 17. 158.
k. Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 9.
l. Singapore.	G. B. Sowerby, Esq. [P.]. 39. 6. 28. 1.
m. — ?	Purchased. 44. 6. 10. 4.

C. *Corallum* vasiform or plate-like, with very numerous short branchlets on the upper surface.

Under surface without branchlets or with a few which are short and oblique.

a. Radial corallites chiefly labellate and thin-walled.

84. *Madrepora spicifera*.

Heteropora microclados, Ehrenberg, Corallenth. d. roth. Meeres, p. 109 (part.).

Madrepora spicifera, Dana, Zoophytes, p. 442, pl. xxxiii. figs. 4 & 5, pl. xxxi. fig. 6; M.-Edwards & Haime, Coralliaires, t. iii. p. 157; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Studer, MB. Akad. Wiss. Berlin, 1878, p. 525; Studer, Mitth. naturf. Ges. Bern, 1880, p. 19; Duncan, Journ. Linn. Soc. Lond. 1886, vol. xxi. p. 20; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18; Faurot, Arch. Zool. Expér. 1888, t. vi. p. 119; ? Ortmann, Zool. JB. 1888, Bd. iii. p. 153; ? ibid. 1889, Bd. iv. p. 511; B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454.

Madrepora microclados, Studer, MB. Akad. Wiss. Berlin, 1878, p. 526; Studer, Mitth. naturf. Ges. Bern, 1880, p. 20; ? Ortmann, Zool. JB. 1888, Bd. iii. p. 153 (*non* Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 576).

Madrepora cytherea, B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454.

? *Madrepora efflorescens*, B.-Smith (*non* Dana), Ann. Mag. N. H. 1890, vol. vi. p. 454.

Corallum broad and shallow vasiform or tabulate, usually 2 to 2.5 cm. thick, but occasionally 5 cm. Under surface complanate and closely reticulate, the branches frequently laterally compressed, about 1.2 cm. by 7 or 8 mm., usually devoid of branchlets. Corallites usually immersed, with a variable number of short appressed tubular corallites, sometimes only near the margin of the colony, at others scattered over the whole surface. In some specimens, which agree in other respects, the immersed corallites of the under surface are almost entirely replaced by appressed and dilated corallites with small aperture. Branchlets on the upper surface numerous, subequal, erect, rarely proliferous near the apex, but often furcate below, apices about 8 mm. apart; length usually 8 to 12 mm., diameter 4 to 5 mm., subterete and more or less distinctly tapering. Axial corallites 1.5 mm. diameter, 0.5 mm. exsert; wall not much thickened. Radial corallites immersed or subimmersed on the upper surface of the branches and at the base of the branchlets, becoming flattened labellate, and imbricate nearer the apex, about 2 mm. long and the lip 1.5 mm. broad; wall thin; in some specimens the lip is not flattened and the corallites are rather more distant. Star rarely distinct, but the directive septa are more or less prominent. Corallum porous; surface reticulate and echinulate; wall striate and more or less distinctly echinulate.

Var. *abbreviata*.

Habit of the type: branchlets 6 to 25 mm. long, obtuse at the apex, with scarcely prominent axial corallites; radial corallites much shorter and more closely crowded. (*Dana*.)

Var. *eucladia*.

Resembles the type form, but the under surface of the frond is covered with stout obsolescent corallites, which are rather crowded and render the surface uneven. Branchlets 18 mm. long and 3 to 4 mm. diameter, 6 mm. apart, regularly tapering and subacute, crowdedly covered with small thin corallites. (*Dana*.)

The small Fiji specimen figured by Dana does not represent the habit and appearance of the species, and it is probable, as hinted by Dana in the text, that the specimen does not belong to this species. I have referred it to *M. armata*.

Var. *sinensis* (= *M. spicifera*, var. *abbreviata*, and *M. cytherea* and ? *M. efflorescens*, B.-Smith).

Several specimens from the Tizard Bank present a general resemblance to this species, but may prove to be specifically distinct. The specimens vary considerably in appearance, but all seem to me to be variations of one form. Corallum shallow, half-vasiform, 4.4 cm. wide and usually under 2 cm. thick. Under surface closely reticulate, sometimes with a few incipient branchlets, chiefly in the general plane. Corallites on the under surface short,

nariform, spreading, with a few immersed ones between. In the specimen referred by Bassett-Smith to *M. efflorescens* nearly all are immersed. In the specimen which most closely resembles *M. spicifera* the branchlets on the upper surface are rarely over 7 mm. long, a great many are only 4 mm.; some are distinctly tapering, others stout and blunt at the apex. Radial corallites of the branchlets short, labellate, rather spreading and unequal, relatively distant, with the wall thin but firm, about 1 mm. diameter and rarely over 1.5 mm. long; on the upper surface of the main branches nearly all the corallites are immersed. Another specimen differs in having nearly all the diminutive branchlets blunt at the apex, with prominent short, round, spreading, labellate, radial corallites, which are not confined to the branchlets, but also occur on the upper surface of the main divisions; many are 1.5 mm. diameter across the lip. In a third specimen prominent corallites almost entirely take the place of immersed ones, on the upper as well as on the lower surface of the colony. Two other specimens are more or less proliferous, one of them (*M. efflorescens*, B.-Smith), in addition to the naked under surface, differs from the others in having very short simple or proliferous branchlets, consisting of an elongate axial corallite with elongate acuminate and appressed radial ones; the axial corallite may project 3 mm. in such cases, but in other parts the branchlets are stouter and closely resemble those of the other specimens.

Indo-Pacific Ocean: Fiji, Tongatabu, New Ireland, Salawatti, New Guinea, New Caledonia, Solomon Islands, China Sea, Singapore, Mergui Archipelago, Ceylon, Gulf of Aden; St. Helena.

<i>a.</i> South Seas (? St. Helena).	Thomas Heddon, Esq. [P.]. 58. 5. 27. 3.
<i>b.</i> James Town, St. Helena.	A. E. Craven, Esq. [P.]. 81. 6. 28. 8.
<i>c, d.</i> Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 14 & 16.
<i>e.</i> — ?	— ? 93. 4. 7. 170.
<i>f.</i> — ?	Purchased. 40. 5. 15. 26.
<i>g.</i> — ?	Purchased. 44. 6. 10. 5.
<i>h.</i> — ?	Purchased. 40. 5. 15. 24.
<i>i.</i> — ?	Purchased. 46. 7. 1. 18.
<i>j, k.</i> — ?	— ? 93. 4. 7. 98 & 99.
<i>l, m.</i> China, probably South.	Fisheries Exhibition. 84. 2. 26. 15 & 16.
<i>n.</i> — ?	W. Thomson Coll. 91. 2. 3. 4.
? <i>o.</i> Treasury Is., Solomon Is.	Dr. Guppy [P.]. 84. 12. 11. 19.
? <i>p.</i> Moreton Bay.	Saville-Kent Coll. 92. 6. 8. 306. (Dead colony.)

Var. *sinensis*.

<i>a-e.</i> Tizard Bank, 6 fath.	H.M.S. 'Rambler.' 89. 9. 24. 89, 91, 113, 118, & 93. 4. 7. 93.
<i>f.</i> — ?	— ? 93. 4. 7. 100.

85. *Madrepora symmetrica*. (Plate XV.)

Madrepora symmetrica, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 470 (? non Rehberg, Abh. naturw. Ver. Hamburg, 1892, Bd. xii. p. 33).

Corallum broad, flat, corymbose, with a short central base, scarcely pedicellate, 35 to

52 cm. broad and 10 to 14 cm. high. Under surface complanate; branches crowded and coalescent, somewhat flattened below; branches 1 cm. thick, with numerous much appressed corallites and a few tubular ones, which are lateral in position and give rise to branchlets in the general plane; some are simple, 8 to 10 mm. long and 2 mm. thick, others bear lateral nariform corallites, others, again, tubular ones, those near the base being elongate and very spreading; immersed corallites almost absent from the under surface. On the upper surface the main branches give rise at intervals to clusters of two to five suberect branchlets; the more central ones are erect and simple or forked, 5 cm. long and 6 mm. thick at the base, distinctly tapering; nearer the margin of the colony the branchlets are oblique and arcuate and bear clusters of 2 to 5 short twigs which are 1 to 2 cm. long and 4 mm. thick; apices 6 to 9 mm. apart. Upper surface of the main branches and base of the branchlets provided with numerous large immersed corallites, with an aperture of 1 mm. Axial corallites about 2 mm. diameter, usually about 1 mm. exsert. Radial corallites ascending, elongate, labellate, and imbricate, 3 to 4 mm. long and 1.5 mm. thick; apices more or less pointed. Corallum very porous and reticulate in section; surface densely echinulate; wall thin, finely striato-reticulate and echinulate, except in the case of the younger ones. Star not recognizable in the prominent corallites or only the directive septa present; in the immersed ones it sometimes consists of six very narrow septa. Two specimens have the apices of some of the twigs subdivided; in the third the majority are proliferous.

Mauritius.

a. Mauritius.
b, c. — ?

Purchased. 78. 2. 4. 9.
Purchased. 49. 1. 4. 1 & 2. } Types.

86. *Madrepora pectinata*. (Plate XXVII. figs. D, E.)

Madrepora pectinata, Brook, Ann. Mag. N. H. 1892, vol. x. p. 460.

Corallum plate-like or vasiform, similar to *M. conferta* and *M. hyacinthus* in habit, 2.5 cm. thick. Under surface flattened, forming an open network, without projecting branchlets; branches 6 to 12 mm. diameter; the stouter ones are usually compressed laterally so as to be oval in section. Corallites on the under surface very short, open bursiform or immersed, thus differing entirely from either *M. conferta* or *M. hyacinthus*; they are nearly 2 mm. diameter; outer part of the wall rarely 1.5 mm. long, the inner part not prominent; aperture nearly 1 mm.; star imperfectly developed. Branchlets on the upper surface rather crowded, usually arranged in groups of 2 to 5 along the course of each branch; length 9 to 14 mm., diameter 4 mm., scarcely tapering; apices about 6 mm. apart. Axial corallites cylindrical, 1.5 mm. diameter or slightly over, rarely over 1 mm. exsert; wall thin and aperture large, with a star of 12 septa, none of which are very prominent. Radial corallites short, spreading, round-labellate, with curved margin to the lip; diameter 1.2 to 1.5 mm., length 1.5, rarely 2 mm.; wall fragile; directive septa scarcely recognizable. The corallites are more spreading than in *M. conferta*, and the apertures are quite distinct when seen from above. Corallum rather porous; surface and wall striate and echinulate.

A variety from the Capricorn Islands has shorter and more distant branchlets on the upper surface, and appears to stand in the same relation to the type specimens as the variety *sinensis* does to typical *M. spicifera*.

Pacific Ocean : Torres Straits and Great-Barrier Reef.

- | | |
|---|--|
| <i>a, b.</i> Thursday Island. | Saville-Kent Coll. 92. 6. 8. 154 & 155. (Types.) |
| <i>c.</i> Capricorn Islands. | Saville-Kent Coll. 92. 6. 8. 156. (Var.) |
| <i>d, e.</i> Wreck Bay, Great-Barrier Reef. | J. B. Jukes, Esq. [P.]. 46. 7. 30. 27 & 27 <i>a.</i> |

87. *Madrepora tenuispicata*.

Madrepora tenuispicata, Studer, Mitth. naturf. Ges. Bern, 1880, p. 20, fig. 1.

Corallum corymbose from a lateral attachment. Main branches horizontal, 1 cm. thick, forming an open network with occasional fusions; under surface of the branches not flattened; they bear a few short and little-spreading twigs and numerous lateral, thick, tubular corallites attached by the inner surface quite to the apex; a few are immersed. Branchlets on the upper surface erect, or arcuate near the margin of the colony, 3 to 4.5 cm. long and 6 or 7 mm. thick at the base, distinctly tapering; apices often provided with slender, little-spreading proliferations, which at first consist of elongate tubular corallites 7 mm. long and 1.5 mm. thick, with the apex often a little incurved. Axial corallites 1.5 mm. diameter, 0.5 to 1.5 mm. exsert; wall a little thickened, but fragile. Radial corallites 2 to 3.5 mm. long, tubo-labellate, somewhat ascending, with or without a pointed apex; wall thin and fragile, excepting on the stouter divisions, where it is distinctly thickened near the base. The upper surface of the main branches is covered with crowded, thin-walled, hemicyclid corallites, with large round aperture and very prominent star; the star of the labellate corallites is not distinct. Cœnenchyma fragile and reticulate in section; surface closely reticulate and echinulate; wall finely striate and echinulate near the base.

The above description is based on the type in the Berlin Museum. Studer's figures (woodcuts) do not give a good idea of the species, and the elongate lip of the radial corallites of the branchlets is not represented.

A specimen in the British Museum agrees in most points with the type specimen, but the branchlets on the upper surface rarely exceed 5 mm. in diameter. The axial corallites have only six septa, but they are very prominent and nearly meet in the middle line. The star of the prominent radial corallites is scarcely recognizable; the outer directive septum is the first to be developed, then the inner one, and finally the remaining primaries in immersed or subimmersed corallites. The specimen forms a vase 36 cm. in diameter and 16 cm. high, with a short subcentral pedicel.

Singapore (*Berlin Museum*).

a. — ?

— ? 93. 4. 7. 121.

88. *Madrepora candelabrum*.

Madrepora candelabrum, Studer, MB. Akad. Wiss. Berlin, 1878, p. 528, pl. ii. fig. 3.

Corallum spreading horizontally from a lateral pedicel; branches coalescent and flattened

below, fused into a plate near the base. The under surface is rendered rough by a few flattened twigs and appressed tubular corallites; immersed corallites are rare. The branchlets on the upper surface are curved, slender, and very proliferous, 4.5 cm. long, and 1 cm. thick at the base, rather crowded. The axial corallites are tubular, 2 mm. thick, and sometimes 4 mm. exsert, margin not rounded. Radial corallites very appressed, labellate, or half-tubular, 4 mm. long near the apex, with long compressed lip; aperture compressed, 2 mm. long. The septa are little developed. Studer's figure shows the majority of the radial corallites immersed, only those near the apex of the branchlets are elongate. The apices are often proliferous, the divisions little spreading. The wall of the elongate corallites near the apex is striate, but scarcely echinulate. The general surface is covered with plate-like echinulations in rows.

Pacific Ocean: New Ireland (*Berlin Museum*).

89. *Madrepora patella*.

Madrepora patella, Studer, MB. Akad. Wiss. Berlin, 1878, p. 526, pl. i. fig. 1.

Corallum shallow-vasiform, almost flat, 38 cm. broad from a central pedicel 5 cm. high. Branches radiating, crowded and coalescent, forming a solid plate in which the course of the individual branches is recognizable, but towards the periphery they are less confluent and form a close network. The under surface is provided with a few immersed corallites, but towards the periphery appressed tubular corallites become gradually more pronounced. On the upper surface of the branches numerous short strongly proliferous twigs or clusters of corallites occur, which are about 1 cm. long and 1.4 cm. thick, and extend obliquely. The axial corallites are cylindrical, thin-walled, 2 mm. diameter, often 3.5 mm. exsert towards the centre of the colony, but less on the peripheral twigs. Radial corallites labellate, imbricate, often with a compressed lip; aperture about 1.5 mm. The septa are not well developed in either the axial or radial corallites.

The species appears closely related to *M. cytherea*, as was recognized by Studer. It is a curious fact that several species of *Madrepora* from the Solomon Islands come very near indeed to species known from other localities and yet present minor differences which may prove to be of specific value.

Bougainville Is., Solomon Islands (*Berlin Museum*).

90. *Madrepora corymbosa*.

Madrepora corymbosa, Lamarek (*non* Dana), Hist. Anim. sans Vert. t. ii. p. 279, ed. 2, p. 447; Deslongchamps, Encyclop. p. 504; Blainville, Manuel d'Actin. p. 112; M.-Edwards & Haime, Coralliaires, t. iii. p. 154; Haeckel, Arabische Korallen, pl. iii. fig. 10; Klunzinger, Korallenth. d. roth. Meeres, p. 24, pl. ii. fig. 2, pl. iv. fig. 1, pl. viii. fig. 21, pl. ix. fig. 16; Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 575; Ortmann, Zool. JB. 1888, Bd. iii. p. 152 (*non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454).

Heteropora corymbosa, Ehrenberg, Corallenth. d. roth. Meeres, p. 112.

Madrepora ramiculosa, Quelch (*non* Dana), 'Challenger' Reef Corals, p. 159.

Madrepora flabelliformis, B.-Smith (*non* M.-Edwards & Haime), Ann. Mag. N. H. 1890, vol. vi. p. 445).

The following is a description of the specimen in the Paris Museum, which is regarded as Lamarck's type:—

Corallum openly vasiform and pedicellate, 29 cm. diameter, and 11 cm. high. The branches of which the vase is composed have a length up to 15 cm., and are 1 cm. diameter near the base; the branches are crowded, with long narrow spaces between, but fusions are numerous to near the margin of the vase. There are numerous immersed and subimmersed corallites on the under surface, and also a large number of wart-like buds, which consist of a central tubercle about 3.5 mm. long and 3 mm. diameter, with a few subimmersed corallites around. These bud-branches are mostly at right angles to the under surface, but a few which are lateral become branched, pressed into the general plane, and may attain a length of 1.5 cm. The superior surface of the main branches is clothed with immersed or short labellate corallites. Innumerable short branchlets arise from this surface, having a maximum length of 2 cm., and 6 or 7 mm. diameter at the base; they are rapidly tapering, arched so as to reach the same level, mostly proliferous, but a few are simple. Axial corallites 1.5 mm. long and broad, wall firm. Radial corallites half-tubular or labellate at an angle of about 45°, a little over 2 mm. long and over 1 mm. thick, very fragile, becoming rapidly shorter below the proliferous apices. Septa of the axial corallites moderately developed, a second cycle sometimes recognizable; in the radial labellate and immersed corallites the directives are very narrow and the others rudimentary. Corallum fragile and very porous in section; surface strongly echinulate and reticulate, but firmer on the main branches; wall strongly ribbed and echinulate, reticulate between.

This species is extremely variable, both in habit and in the character of the corallites, and many specimens which are referable to it differ in a marked degree from the type specimen. The axial corallites are cylindrical, usually 2 or occasionally 3 mm. broad and 2 to 3 mm. long, with the wall a little thickened; the size varies considerably in different specimens. Radial corallites half-tubular, dimidiate or spathulate, 1 to 2 mm. broad and 2 to 3 mm. long, more spreading and crowded near the apex; immersed at the base of the branchlets and on the stouter parts. The under surface in the subcomplanate forms always bears numerous short twigs and elongate tubular corallites up to 4 or 5 mm. in length. The form of the colony is either:—

- a. Vasiform or subvasiform. (Var. *vasiformis*.)
- b. Hemispherical or bushy, with slender elongate middle branches and short, much divided marginal ones. (Var. *hemispherica*, Ehrb.)
- c. Broad corymbose, convex on the upper surface, with the branchlets and corallites as in form *d*; compare Klunzinger's pl. ix. fig. 16. (Var. *corymbiformis*.)
- d. Cespito-tabulate, with the main branches extending horizontally, and the branchlets short and stout. (Var. *cespito-tabulata*, Klz.)
- e. Incrusting, without or with much depressed branchlets, as in *M. seriata*, var. *depressa*. (Var. *depressa*, Klz.)

Klunzinger observes that some specimens of the cespito-tabulate form are similar to *M. cytherea*, Dana, but may usually be distinguished by the less pointed corallites, the less developed branches, and the less naked under surface. In other cases, however, it is extremely difficult to separate the two forms, and ultimately it may be necessary to regard both as varieties of one species.

Indo-Pacific Ocean: Red Sea, Rodriguez, Ramesvaram, China Sea, New Holland, Great-Barrier Reef, Fiji, Tahiti.

Var. *vasiformis*.

- | | |
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| <p><i>a.</i> Aden.
 <i>b-d.</i> Rodriguez.
 <i>e.</i> Naples!
 <i>f.</i> Tizard Bank.

 <i>g.</i> — ?
 <i>h.</i> Wreck Bay, Great-Barrier Reef.
 <i>i.</i> Blackwood Bay.</p> | <p>Major Yerbury [P.]. 87. 12. 11. 19.
 Royal Society [P.]. 76. 5. 5. 102, 105 & 108.
 P. de la Garde, Esq. [P.]. 93. 4. 7. 140.
 H.M.S. 'Rambler.' 89. 9. 24. 119. (= <i>M.</i>
 <i>flabelliformis</i>, B.-Smith.)

 Mrs. W. H. Ince [P.]. 82. 11. 16. 1.
 J. B. Jukes, Esq. [P.]. 46. 7. 30. 19.
 J. B. Jukes, Esq. [P.]. 45. 8. 12. 11.</p> |
|--|---|

Var. *hemisphaerica*.

- | | |
|---|---|
| <p><i>a.</i> Red Sea.
 <i>b.</i> Great-Barrier Reef.
 <i>c.</i> Fiji.</p> | <p>R. McAndrew, Esq. [P.]. 93. 4. 7. 162.
 Saville-Kent Coll. 92. 6. 8. 305.
 H.M.S. 'Challenger.' 86. 12. 9. 248. (= <i>M. ramiculosa</i>,
 Quelch.)</p> |
|---|---|

Var. *corymbiformis*.

- | | |
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| <p><i>a.</i> Ramesvaram.
 <i>b.</i> ? Ramesvaram.
 <i>c.</i> — ?</p> | <p>Madras Museum. 81. 11. 25. 11.
 ? Madras Museum. 93. 4. 7. 128.
 Purchased. 47. 1. 1. 10.</p> |
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Var. *cæspito-tabulata*.

- | | |
|---|---|
| <p><i>a.</i> Red Sea.
 <i>b.</i> Wreck Bay, Great-Barrier Reef.
 <i>c.</i> Rocky Island.
 <i>d.</i> — ?</p> | <p>Dr. Klunzinger [C.]. 86. 10. 5. 13.
 J. B. Jukes, Esq. [P.]. 46. 7. 30. 14.
 Saville-Kent Coll. 92. 6. 8. 313.
 — ? 93. 4. 7. 109.</p> |
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91. *Madrepora cytherea*.

Madrepora cytherea, Dana, Zoophytes, p. 441, pl. xxxii. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 157; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 25, pl. ii. fig. 4, pl. iv. fig. 2, pl. ix. fig. 20; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45; Quelch, 'Challenger' Reef Corals, p. 165; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15; Ortmann, Zool. JB. 1888, Bd. iii. p. 153; *ibid.* 1889, Bd. iv. p. 511 (*non* Ridley, Ann. Mag. N. H. 1883, vol. xi. p. 259; *non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454).

? *Madrepora efflorescens*, Ortmann, Zool. JB. 1888, Bd. iii. p. 153.

Corallum vasiform and pedicellate, tabulate, or frequently subvirgate when young. Upper surface usually flattened or concave; under surface almost without any twigs or buds, but provided with numerous verruciform or annular, often dilated corallites. Vasiform specimens sometimes attain a diameter of 1.2 m., and a height of 30 to 60 cm., pedicel 3 to 8 cm. thick. The main branches are reticulately coalescent, the meshes of the network being 5 to 10 mm. wide. Branchlets on the upper surface more or less crowded, many are short and acervato-proliferous; length 1 to 2.5 cm., diameter 5 to 10 mm.; but without the radial corallites the majority are little broader than the axial corallite. Axial corallites

2 mm. in diameter, and 2 to 3 mm. exsert; wall a little thickened, margin not rounded. Radial corallites 2 to 4 mm. long, and 1 to 1.5 mm. diameter, chiefly labellate, with small often styliform lip, but the larger ones are half-tubular as in *M. corymbosa*; the upper corallites are very unequal in length and diameter, and are usually more appressed than in *M. corymbosa*, the lower ones and those on the main divisions are mostly immersed. Star indistinct, the inner directive septum usually recognizable, and sometimes the other primaries also, particularly in the immersed corallites. Corallum rather porous; surface subreticulate, ribbed and echinulate; wall strongly striate and echinulate.

Var. *globata*, Klunzinger.

Colony massive and convex from an incrusting base.

A specimen from Diego Garcia forms a large rounded subvasiform colony, the vase being produced as in *M. arcuata* by the overlapping and fusion of the posterior lobes of an originally arched and flabellate specimen. In the character of the under surface this specimen comes nearer to specimens from Tahiti than to those obtained by Klunzinger from the Red Sea.

Generally speaking the Pacific form has the under surface covered with short usually much dilated tubular corallites, and those on the upper surface have a rather porous wall. In Red Sea specimens the under surface has no dilated corallites, and the majority are immersed or subimmersed; on the upper surface the wall of the radial corallites is dense and firm.

The species forms extensive terraces in the Red Sea, and sometimes is very difficult to distinguish from certain forms of *M. corymbosa*. Tahiti specimens are vasiform and differ from many Red Sea specimens in various details, particularly in the dilated corallites of the under surface and the extremely numerous proliferations on the upper surface.

Indo-Pacific Ocean: Tahiti, Solomon Islands, Singapore, Ceylon, Diego Garcia Mauritius, Red Sea.

<i>a.</i> Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 31.
<i>b, c.</i> Tahiti.	H.M.S. 'Challenger.' 85. 2. 1. 19 & 86. 12. 9. 409.
<i>d.</i> Singapore.	Purchased. 78. 6. 6. 14.
<i>e.</i> Solomon Islands.	Dr. Guppy [C.]. 84. 12. 11. 24.
? <i>f.</i> Diego Garcia.	G. C. Bourne, Esq. [C.]. 92. 5. 29. 1.
<i>g, h.</i> Ceylon.	Haeckel Coll. 92. 12. 15. 19, 27 & 29.
<i>i.</i> — ?	— ? 93. 4. 7. 116.
<i>j.</i> — ?	Bowerbank Coll. 77. 5. 21. 183.
<i>k.</i> — ?	— ? 93. 4. 7. 126. (Var.)

92. *Madrepora armata*. (Plate X. figs. A, B.)

Madrepora spicifera, Dana, Zoophytes, p. 443 (part.), pl. xxxiii. figs. 4 & 4 a only.

? *Madrepora cytherea*, Quelch, 'Challenger' Reef Corals, p. 165 (part.).

Madrepora armata, Brook, Ann. Mag. N. H. 1892, vol. x. p. 452.

The small specimen figured by Dana under the name *M. spicifera* does not appear to belong to that species, but, as Dana suggested, may be a young form of *M. cytherea*. It differs from that species in two important points, viz.: the scarcity of proliferous corallites on

the branchlets of the upper surface, and the occurrence of numerous spreading tubular corallites on the under surface. There are several specimens in the collection of the British Museum which agree with Dana's figure in these respects, and at first sight there appears little affinity to specimens of *M. cytherea* from Tahiti, the original habitat. The colony is umbellate rather than vasiform, and is flat on the upper surface excepting in very small colonies where the central branches are not so long as the others. That it is not the ordinary young form of *M. cytherea* appears to be shown by the fact that in specimens of 25 cm. diameter scarcely any proliferous corallites occur, whereas in the normal specimen of *M. cytherea*, of 30 cm. diameter, proliferous corallites are numerous and the corallites of the under surface are dilated verruciform. It appears, therefore, more convenient to regard it as distinct.

Corallum vasiform or umbellate, pedicellate, flat above excepting when young, under surface oblique. Height of the corallum 15 cm., diameter 25 cm.; diameter of pedicel 6 to 8 cm. The outer branches are about 1.2 cm. thick and 9 to 12 cm. long, crowded and a little compressed laterally. On the outer or under surface they bear numerous spreading, tubular, often proliferous, corallites, 1.5 to 2 mm. diameter and 2 to 4 mm. long if simple, but the majority are in some specimens more elongate and bear buds. On the pedicel these corallites form short tapering branchlets spreading at right angles and often 1 cm. in length. The interval between these twigs and proliferous corallites is occupied by short-lipped or immersed ones. The branchlets on the upper surface are usually arranged in groups of 2 to 6 from a common base; those in the centre are longest, and the apices are about 8 mm. apart; length 1.5 to 4 cm., diameter 6 mm. or a little over, apices rarely proliferous unless near the margin of the colony. Axial corallites 2 mm. diameter, 1 to 2 mm. exsert, cylindrical, with porous and strongly striate wall. Radial corallites spreading tubo-labellate or gutter-shaped, with very thin fragile and reticulate wall; length 2 to 3 mm., diameter 1 to 1.5 mm., becoming shorter and finally immersed below. The corallites are not so spreading on the marginal branchlets as nearer the centre. Star scarcely at all developed, usually only the directive septa are recognizable. Corallum very porous; surface striato-echinulate; wall striato-reticulate, echinulate near the base.

Indo-Pacific Ocean: Singapore, Diego Garcia, ? Tahiti.

a. Singapore?	W. E. Hands, Esq. [P.]. 50. 1. 16. 1.	} Types.
b. Singapore.	T. Ingall, Esq. [P.]. 57. 4. 6. 1.	
c, d. Diego Garcia.	G. C. Bourne, Esq. [C.]. 91. 4. 9. 6 & 7.	
? e. Tahiti.	H.M.S. 'Challenger.' 86. 12. 9. 410. (= <i>M. cytherea</i> , Quelch, part.)	
f. — ?	Purchased. 40. 5. 29. 1.	
g. — ?	— ? 93. 4. 7. 164.	
h. — ?	— ? 49. 5. 15. 11.	
i-k. — ?	— ? 93. 4. 7. 124, 125 & 131.	

93. *Madrepora arcuata*. (Plate XII.)

Madrepora arcuata, Brook, Ann. Mag. N. H. 1892, vol. x. p. 452.

Corallum stalked, flabellate or subvasiform. The largest specimen is 50 cm. long, and consists of a thin plate-like flabellum, extending obliquely from a round pedicel 5 cm. in diameter. The proximal portion, 20 cm. in length, is only about 10.5 cm. wide, the distal part forms a fan-shaped growth 34 cm. across, rounded anteriorly, and with the posterior margins a little incurved; the thickness from the under surface to the apex of the branchlets on the anterior surface is only 2 cm. The under surface consists of a close reticulum of slender branches with narrow and elongate spaces between; diameter of the branches 6 mm. The under surface is practically without branchlets, and the branches are covered with much appressed tubular corallites; near the base the majority become short and finally immersed, and immersed corallites occur also in the lines of fusion. On the upper surface the branchlets are slender, arcuate and crowded, apices 5 mm. apart, often less in the case of proliferous apices. The branchlets are usually about 1.2 cm. long and 4 mm. thick, including the radial corallites; they are arranged in single or double series along the upper surface of a branch, some are simple, in other cases 2 to 5 twigs arise from a common base. Axial corallites cylindrical, 1.5 mm. diameter and about 1.5 mm. exsert; wall porous and finely striate. Radial corallites tubo-labellate at an angle of about 45°; lip pointed or gutter-shaped; length 2.5 mm., diameter 1 mm. Star very imperfect, the directive septa scarcely recognizable. Corallum very porous; surface openly spongy and echinulate; wall thin, striato-reticulate, echinulate below.

In one of the specimens which appears to have grown erect the posterior margins of the flabellum have arched inwards, so as to overlap and become fused together, but below the point of fusion a space occurs, the floor of which consists of branchlets which at an earlier period formed part of the upper surface of the colony. The specimen is about 14 cm. high and 20 cm. diameter; the corallites on the under surface are shorter and more spreading than usual. A third specimen in the collection consists of 6 or 8 small colonies forming a cluster on a piece of dead coral; the largest colony is about 9.5 cm. high and 14 cm. broad.

Pacific Ocean: Samoa Islands.

a, b. Samoa Islands.

Purchased. 62. 1. 27. 4 & 5.

c. Samoa Islands.

Rev. S. J. Whitmee [P.]. 75. 10. 2. 9. } Types.

94. *Madrepora microclados*.

Heteropora microclados, Ehrenberg, Corallenth. d. roth. Meeres, p. 109 (part.); non *M. microclados*, auctt.

Madrepora flabelliformis, M.-Edwards & Haime, Coralliaires, t. iii. p. 157; Ortmann, Zool. JB. 1888, Bd. iii. p. 153; *ibid.* 1889, Bd. iv. p. 511 (*non* Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 575; *non* Ridley, Ann. Mag. N. H. 1883, vol. xi. p. 259).

The specimens referred by Ehrenberg to *H. microclados* appear referable to two, possibly to three species. Those which he mentions as forming part of the Berlin-Museum collection are, with one exception, identical with *M. spicifera*, Dana. As already indicated by Studer, slight differences occur; but nothing which, in my opinion, entitles them to rank as a distinct species. Ehrenberg, however, also refers to a fine specimen in the cabinet of the "Gesellschaft der naturforschenden Freunde." This specimen also is now in the Berlin Museum; it differs specifically from the other specimens, and is practically identical with the type of *M. flabelliformis*, Ed. & H. On comparing the various specimens with Ehrenberg's diagnosis, I find that the specimen formerly in the possession of the "Ges. naturf. Freunde" agrees closely—so closely, indeed, that it appears to have been the specimen on which the diagnosis was based; on the other hand, the remaining specimens do not conform to the description. Under these circumstances it appears necessary to regard the specimen in question as the type, and the others as *M. spicifera*, Dana. In this case, *M. flabelliformis*, Ed. & H., becomes a synonym. The following is a description of the specimen:—

Corallum flabellate or shallow vasiform; the part preserved consists of a frond 26 cm. high and 24 cm. wide above, but tapering almost to a point at the base. Under surface complanate; branches laterally compressed, 12 by 8 mm., rather distantly coalescent. Surface almost naked, with numerous immersed corallites 0·75 to 1 mm. diameter, and a few short branchlets pressed into the general plane, 1 to 1·8 cm. long and about 4 mm. thick; each consists of an elongate and thick axial corallite with subimmersed radial buds. On the upper surface the branchlets are slender, frequently oblique and rather distant, 1 to 2·5 cm. long and 4 or 5 mm. thick at the base. Axial corallites 1·5 to 2 mm. diameter and 1 to 3 mm. exsert, or even more; wall not much thickened; a few of the apices are proliferous. The radial corallites of the main divisions are immersed or subimmersed. At the base of the branchlets the corallites have the outer part of the wall short and thin, and the aperture is wide; towards the apex the wall gradually becomes more elongate and labellate, and spreads at an angle of about 40°; length 1 to 4 mm., diameter 1·5 mm.; the wall is always thin, and the aperture wide and circular. Corallum fragile; surface reticulate and strongly echinulate; wall broadly striate, echinulate near the base.

The type of *M. flabelliformis*, Ed. & H., consists of a fan-shaped frond 32 cm. high and 38 cm. across the broadest part. It agrees closely with the specimen already described in the majority of its characters. The branchlets on the upper surface arise singly or in groups of 3 to 6. The upper radial corallites are labellate or half-tubular, a little unequal, 1·3 mm. diameter and up to 2·5 mm. long. The surface of the corallum consists of a close vermiculate network with fine echinulations. All the septa are narrow, and in the immersed corallites are almost indistinguishable.

Indian Ocean.

b. *Corallum prostrate. Radial corallites nariform.*95. *Madrepora aculeus*.

Madrepora aculeus, Dana, Zoophytes, p. 450, pl. xxxii. fig. 6; M.-Edwards & Haime, Coralliaires, t. iii. p. 155; ? Quelch, 'Challenger' Reef Corals, p. 160; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 12; ? Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 153).

Corallum prostrate; branches stout and very uneven, much and closely subdivided. Branchlets on the under surface short, angular, horizontal, and covered with long tubular corallites. On the upper surface the branchlets are exsert, but rise with a curve, very crowded, 4 mm. thick and often 5 cm. long, subacute. Axial corallites prominent (often 2 mm.); radial corallites not crowded, small, round nariform, with the edge thin, 1 mm. diameter and 2 mm. long; wall striate, but not echinulate. Star mostly distinct, the directive septa broadest. (*Dana.*)

Indo-Pacific Ocean: Fiji, ? Philippines, ? China Sea.

? a. Samboangan, Philippines.

H.M.S. 'Challenger.' 86. 12. 9. 249.

? b. Tizard Bank, $8\frac{1}{2}$ fathoms.

H.M.S. 'Rambler.' 89. 9. 24. 105.

96. *Madrepora glochicladus*.

Madrepora aculeus, Ortmann (*non* Dana), Zool. JB. 1888, Bd. iii. p. 153.

Corallum prostrate, resembling *M. aculeus* in habit, but provided with stouter branchlets and much larger radial corallites. The type specimen consists of a mass of branches 36 cm. long, the main divisions 1.7 cm. thick. The branchlets on the upper surface are arched, 8 cm. long, simple or divided near the base into 2 or 3 little-spreading divisions about 1 cm. thick. Axial corallites 2.5 to 3 mm. diameter, 1 to 2 mm. exsert. Radial corallites broad nariform, more or less spreading, 2.5 and occasionally 3 mm. diameter, 3 to 4 mm. long, but becoming shorter and subimmersed below. The star consists of 12 well-developed septa. Corallum moderately porous near the apex, but stony below; surface and wall striate and echinulate.

Indian Ocean (*Strassburg Museum*).

a. — ?

W. Thomson Coll. 91. 2. 3. 5.

c. *Corallum subcorymbose or frondose. Radial corallites open nariform or labellate, with a wide circular aperture.*97. *Madrepora surculosa*.

Madrepora surculosa, Dana, Zoophytes, p. 445, pl. xxxii. figs. 4 & 5; M.-Edwards & Haime, Coralliaires, p. 158; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Duncan, Journ. Linn. Soc. Lond. 1886, vol. xxi. p. 19; Quelch, 'Challenger' Reef Corals, p. 166; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 42 (*non* Studer, Mitth. naturf. Ges. Bern, 1880, p. 20).

Corallum corymbose, short and stout pedicellate, flattened above. The branches on the under surface extend obliquely and are more or less fused together into a solid plate without twigs; but where a space occurs between adjoining branches the margin bears stout spreading tubular corallites, and immersed corallites are scattered quite irregularly over the under surface. In other cases where the under surface is not so solid the prominent corallites are much more numerous, and some are proliferous and form short twigs in the general plane. On the upper surface the branchlets are crowded, short and tapering, simple or collected into groups of 2 to 5, frequently proliferous at the apex; about 1.5 to 3 cm. long and 6 to 8 mm. thick at the base, frequently angular in the basal part. Axial corallites cylindrical, 1.5 mm. diameter, 1 to 2 mm. exsert; wall thin, porous and strongly striate. Radial corallites crowded, ascending, open labellate, with rounded apex, a little unequal owing to incipient proliferous corallites; 2 to 3 mm. long, 1 to 1.5 mm. thick; wall very fragile, striato-reticulate. Star not distinct, even the directive septa not always recognizable. Corallum very porous; surface of branchlets strongly echinulate, denser and more finely echinulate on the under surface.

Usually at a point about 1 cm. from the apex of a branchlet the corallites become shorter and finally immersed, but the aperture is always about 1 mm. The corallites are slightly more spreading near the margin of the colony, but the angle rarely exceeds 45°.

In Dana's figure 4 *a* the elongate lip of the corallites is not shown.

The specimens in the Saville-Kent Collection differ from the Tahiti specimens in habit, but the corallites are of the same form. The habit is usually more prostrate and half-vasiform, without prominent tubular corallites on the under surface, but, on the other hand, one or two show the erect tubular corallites very well indeed.

Indo-Pacific Ocean: Tahiti, Fiji, Great-Barrier Reef, East Indies, Mergui Archipelago, ? Ceylon.

<i>a-c.</i> Tahiti.	H.M.S. 'Challenger.' 85. 2. 1. 8 & 9, 92. 10. 16. 0.
<i>d.</i> Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 157.
<i>e.</i> Capricorn Island.	Saville-Kent Coll. 92. 6. 8. 160.
<i>f-i.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 153, 158, 159 & 162.
? <i>j.</i> Ramesvaram.	Madras Museum. 93. 4. 7. 129.
<i>k.</i> — ?	Purchased. 45. 9. 24. 5.

98. *Madrepora macrostoma*. (Plate XIX. fig. B.)

Madrepora macrostoma, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 464.

Corallum subcorymbose or umbellate, 33 cm. broad and 15 cm. high, consisting of crowded erect branches springing from an obconical fastigiate cluster of dead coral. Branches 4 cm. long, simple or consisting of two or three subparallel divisions about 1 cm. thick, scarcely tapering. Apices a little over 1 cm. apart, the marginal ones very proliferous and sometimes acervate. Axial corallites 2.5 to 3 mm. thick and 1 mm. exsert. Radial corallites broad, round and ascending tubo-labellate, 3 mm. long, and 2 to 2.5 mm. diameter; aperture large and circular, wall very thin. Star well-developed but deep, consisting of twelve

prominent septa. Lower down the corallites become thickened, verruciform, or immersed. Corallum very porous and reticulate in section; surface openly reticulate; wall striato-reticulate, echinulate near the base.

Mauritius.

a. Mauritius.

Purchased. 78. 2. 4. 7. (Type.)

99. *Madrepora anthocercis*. (Plate XIII. fig. C.)

Madrepora coronata, Brook (*non* Rehberg), Ann. Mag. N. H. 1892, vol. x. p. 456.

Corallum cespitose or, in large specimens, forming broad much-flattened clumps from an incrusting base; diameter 20 to 24 cm., height 6 cm., base 12 cm. diameter. Branches short, crowded, acervate, undivided, excepting near the margin, often broader at the apex than the base owing to the acervate condition and the presence of elongate corallites at and round the apex; length 1.2 to 3 cm., or more in the case of marginal branches; diameter 5 to 7 mm. at the base, frequently 1 cm. or more at the apex; apices a little over 1 cm. apart. Axial corallites cylindrical, 2 or more frequently 3 mm. diameter and about 4 mm. exsert; wall porous and strongly striate; star well-developed but deep. The apex of a branch is rarely simple, usually two or more corallites surrounding the axial corallite increase in size so as to be indistinguishable from it—indeed, in certain cases the parent corallite becomes almost obliterated by the formation of stout proliferous corallites around it. Radial corallites relatively large, ascending, but with wide aperture, wall rather thin, margin often horizontal; the form is variable, nariform at first, but with increase in size dimidiate, tubular or funnel-shaped; length 2 to 4 mm., diameter 1.5 to 2.5 mm.; those near the apex are crowded, those lower down are rather distant and less prominent. Star of the radial corallites moderately developed, the directive septa distinctly broader and stouter than the others. Corallum porous; surface covered with strongly dentate plates; wall deeply striate and echinulate.

Pacific Ocean : Great Barrier Reef area.

a. Palm Island.

Saville-Kent Coll. 92. 6. 8. 235.

b, c. Rocky Island.

Saville-Kent Coll. 92. 6. 8. 236 & 7. } Types.

100. *Madrepora recumbens*. (Plate XXVII. fig. F.)

Madrepora recumbens, Brook, Ann. Mag. N. H. 1892, vol. x. p. 461.

Corallum cespitose at first, becoming flattened, frondose or semivasiform with increase in size; largest specimen 30 cm. broad. Proximal portion of main divisions fused into a solid plate without branchlets on the outer surface, but with small scattered immersed corallites; distal parts more or less confluent; many of the corallites are nariform or subtubular, but do not form projecting twigs. Branchlets on the upper surface short, subconical and somewhat arcuate, 1 to 2.5 cm. long, 8 to 13 mm. diameter at the base, rapidly tapering, and usually simple. Where the outline of the main divisions is distinguishable the branchlets are seen to be arranged in a single row on the upper surface of each branch, with immersed cells in the lines of fusion between adjoining branches. Apices usually about 1.2 cm. apart, but some-

what irregular. Axial corallites cylindrical, usually 1·8 to 2 mm. diameter, rarely 2·5 mm.; 1·5 mm. exsert; wall usually thin but firm, margin plane. Radial corallites round, open nariform to tubo-nariform or tubo-labellate; the inner part of the wall not so prominent as the outer; others between are smaller or immersed; the prominent corallites are often arranged in irregular longitudinal rows; length 1 to 2 mm., diameter 1·5 to 2 mm.; outer part of the wall firm but not thick, the inner part is delicate. Star not prominent, usually only the directive septa are recognizable. Corallum rather dense; surface dense but reticulate in parts, strongly echinulate; wall striato-echinulate.

Pacific Ocean: Great-Barrier Reef area.

<i>a-c.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 269 to 271.	} Types.
<i>d.</i> Green Island.	Saville-Kent Coll.	92. 6. 8. 272.	
<i>e, f.</i> Capricorn Islands.	Saville-Kent Coll.	92. 6. 8. 273 & 161. (Var.)	

D. Branchlets on the under surface suberect and often of considerable importance. In other respects this Division resembles the M. spicifera group (C. a).

101. *Madrepora hyacinthus*.

Madrepora hyacinthus, Dana, Zoophytes, p. 444, pl. xxxii, fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 158; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16; Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 455 (*non* Quelch, 'Challenger' Reef Corals, p. 164).

Madrepora vastula, Bassett-Smith (*non* Quelch), Ann. Mag. N. H. 1890, vol. vi. p. 455.

Corallum vasiform, pedicellate, frond 2·5 to 3·2 cm. thick; branches sparingly coalescent; below, branchlets crowded and spreading, 8 to 12 mm. long, often proliferous; above, branchlets slender (about 3 mm. thick), nearly simple, sometimes proliferous, 12 to 18 mm. long. Corallites tubo-labellate, not fragile, 2 to 3 mm. long, lip not at all flattened; cells open, with an indistinct star. Axial corallites cylindrical, prominent. The branchlets below are muricate (oblique), nearly like those above. The type specimen is a vase, 12·5 cm. in diameter. (*Dana.*)

The specimens from the Tizard Bank, referred by Bassett-Smith to this species and to *M. vastula*, agree more nearly with Dana's description than any other specimens which I have seen; but the twigs on the under surface are not so long as might be expected from the diagnosis. They have the following characters:—Fronds 3·5 to 4 cm. thick, attachment lateral; rather regularly reticulate, composed of branches 4 to 6 mm. thick, with appressed tubular corallites and a few short spreading twigs not over 7 mm. long on the under surface. Branchlets on the upper surface arched; two or more arise from a common base, and sometimes each is again subdivided. Axial corallites cylindrical, 2 mm. (rarely 2·5 mm.) diameter and 1 to 2 mm. exsert. Radial corallites dimidiate or labellate, with a curved outer surface, and becoming shorter, nariform, and finally immersed on the main branches; length 2·5 to 3 mm., diameter 1·5 mm.; wall firm. Very few truly immersed corallites occur in any part of the corallum. In the axial corallites the septa are in two cycles, but the second is very narrow;

in the radial corallites rarely more than the directive septa are recognizable. Wall striate at first, echinulate at the base, the whole surface becoming covered with plate-like echinulations later.

Pacific Ocean: Fiji, Great-Barrier Reef, Tizard Bank.

- | | |
|--------------------------------|---|
| a. Tizard Bank, 9½ fathoms. | H.M.S. 'Rambler.' 89. 9. 24. 90. (= <i>M. hyacinthus</i> ,
B.-Sm.) |
| b. Tizard Bank, 9½ fathoms. | H.M.S. 'Rambler.' 89. 9. 24. 116. (= <i>M. vastula</i> ,
B.-Sm.) |
| c, d. Tizard Bank, 9½ fathoms. | H.M.S. 'Rambler.' 93. 4. 7. 97 & 166. |
| e. Palm Island. | Saville-Kent Coll. 92. 6. 8. 220. |
| f. —? | —? 47. 1. 1. 11. |

102. *Madrepora conferta*.

? *Madrepora microcladus*, Brüggemann (*non* Ehrenberg), Phil. Trans. 1879, vol. clxviii. p. 575.

Madrepora conferta, Quelch, 'Challenger' Reef-Corals, p. 164, pl. x. fig. 3; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 13.

Madrepora hyacinthus, Quelch (*non* Dana), 'Challenger' Reef-Corals, p. 164.

Madrepora vastula, Quelch, 'Challenger' Reef-Corals, p. 165, pl. x. fig. 4 (*non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 455).

Corallum pedicellate, vasiform or plate-like, about 3 cm. thick; either very shallow (*M. hyacinthus*, Quelch) or funnel-shaped (*M. vastula*, Quelch). Main branches 1.5 cm. or more in diameter, often laterally compressed, but those which appear on the under surface are rarely over 5 to 6 mm. diameter, closely packed and intricately coalescent with narrow elongate meshes. On the under surface there are numerous short ramiculi and proliferous corallites not over 8 mm. long and the majority under 5 mm., some of the longer ones extend obliquely from the sides of the branches, but the majority stand off at right angles (Quelch says, "closely appressed into the plane of the frond"). The under surface of the network between the proliferations is supplied with erect tubular corallites 2 to 2.5 mm. long and 1.5 mm. diameter, with immersed and subimmersed ones between. The "solid areas" described by Quelch are probably accidental and cannot be considered as characteristic of the species. The branchlets on the upper surface are short, erect, and very crowded, their apices rarely over 5 mm. apart; they are usually 8 to 12 mm. long and 4 to 6 mm. broad just below the apex, but rather narrower below where the radial corallites are shorter; many are proliferous, and those near the margin of the colony extend obliquely and may be longer. Axial corallites about 1.75 mm. in diameter, 1 mm. exsert or a little more. Radial corallites rather spreading, boat-shaped or broad, and curved labellate; wall thin and not compressed, 1 to 1.5 mm. long and 1 mm. broad, or slightly more across the lip; towards the base of the branchlets the corallites are shorter and become immersed or subimmersed on the branches. Corallum rather dense, but porous near the apex of the branchlets; surface striato-reticulate and echinulate, wall striato-echinulate. The primary septa are all narrow in the radial corallites, sometimes only the directives are recognizable.

The three 'Challenger' specimens referred by Quelch to *M. hyacinthus*, *M. conferta*, and *M. vastula* appear to me to belong to one species, and differ chiefly in the shape of the vase or plate. All agree in the characters of the under surface, which supply the chief distinction from *M. hyacinthus*, Dana. The specimen referred to *M. hyacinthus* by Quelch differs from the other two in having usually shorter and more proliferous branchlets on the upper surface, but especially in the axial corallites, many of which are slightly over 2 mm. diameter, with a wide shallow cup.

Indo-Pacific Ocean : Tongatabu, Fiji Islands, Great-Barrier Reef, Torres Straits, Amirante Islands, ? Rodriguez.

<i>a.</i> Reefs, Fiji.	H.M.S. 'Challenger.' 85. 2. 1. 12. (Type.)
<i>b.</i> Kandavu, Fiji.	H.M.S. 'Challenger.' 85. 2. 1. 17. (Type of <i>M. vastula</i> , Quelch.)
<i>c.</i> Levuka, Fiji.	H.M.S. 'Challenger.' 85. 2. 1. 2. (= <i>M. hyacinthus</i> , Quelch.)
<i>d.</i> Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 17. (Young colony.)
<i>e, f.</i> Eagle Island, Amirante Islands : 10 fathoms.	H.M.S. 'Alert.' 82. 10. 17. 141 & 135.
<i>g, h.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 149 & 264.
<i>i-k.</i> Cleremont Island.	Saville-Kent Coll. 92. 6. 8. 150 to 152.
<i>l.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 265. (Var.)
? <i>m.</i> Rodriguez.	Royal Society [P.]. 76. 5. 5. 99. (= <i>M. microcladus</i> , Brügg.)

103. *Madrepora delicatula*. (Plate XXVIII. figs. D & E.)

Madrepora delicatula, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 461.

Corallum vasiform or extending horizontally; branches not over 8 mm. thick, laxly coalescent, but not complanate, and bearing on the under surface numerous slender branchlets almost at right angles, 1 cm. or more in length and generally 2.5 mm. diameter at the base, provided with distant, appressed tubular buds; appressed tubular and immersed corallites also occur between the twigs. The upper surface bears slender arcuate branches, not over 5 mm. thick, which give rise to delicate ascending branchlets, singly or in groups of two or three; these are 1.5 to 2.5 cm. long and scarcely 3 mm. thick at the base, apparently tapering, owing to the radial corallites being shorter near the apex. Axial corallites 1.5 mm. diameter, usually 2.5 mm. exsert. Radial corallites rather distant, round-nariform, or labellate, 1 to 1.3 mm. wide and 1 to 4 mm. long; the lip of the more elongate ones is frequently a little incurved; wall thin, aperture round, star indistinct. Corallum very porous and fragile; surface vermiculato-echinulate; wall finely striate, echinulate near the base.

Solomon Islands.

<i>a.</i> Treasury Island, Solomon Islands.	Dr. Guppy [P.]. 84. 12. 11. 23. (Type.)
<i>b.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 148.

104. *Madrepora kenti*. (Plate XI. fig. B.)

Madrepora kenti, Brook, Ann. Mag. N. H. 1892, vol. x. p. 458.

Corallum horizontal or corymbose, in either case the main branches are divided into two subparallel series of branches; the upper series bear branchlets on the superior surface and the lower series bear branchlets which are almost equally important on the inferior surface; the main branches are 2 to 2.5 cm. thick. The inferior series of branchlets in the horizontal form extend obliquely forwards, and are 3.5 to 5 cm. long and 5 to 7 mm. thick at the base, simple or proliferous at the apex; the apices are nearly all arranged in one plane. Corallites large, very distant, round, appressed tubiform; inner part of the wall not free in the shorter corallites, but more or less prominent in the more elongate ones; length of the outer part of the wall 2 to 4 mm., diameter 2.5 mm., aperture 1.5 mm. The radial corallites are longest near the apex of a branchlet and gradually decrease in length towards the base; scarcely any are completely immersed. The branchlets on the upper surface are similar to those below but less oblique; length 3.5 to 6 cm., diameter at the base 7 to 10 mm., the more slender ones are scarcely tapering. Axial corallites 2.5 to 3 mm. diameter, cylindrical, margin plane, aperture 1.5 mm. Radial corallites appressed tubular, similar to those below but more crowded and more prominent; the majority have the outer part of the wall produced into a rounded lip (ligulate), but the inner part is usually not free; length 3 to 4 mm., diameter 2.5 mm. across the lip, but usually rather narrower at the base; in most cases the corallites are almost as prominent just above the base of a branchlet as near the apex. Star moderately developed, the two directive septa prominent, the other primaries of medium breadth, and frequently a narrow second cycle is also present. Corallum moderately porous in section, but dense and pitted at the surface, echinulate; wall striato-reticulate, echinulate at the base.

The corymbose variety has more crowded and clustered branchlets; on the upper surface two or three often spring from the same stalk, but the same bifarious condition of the branches and branchlets occurs as in the horizontal form. The outer part of the wall of the radial corallites is here not quite so spreading, and the inner part of the wall is rarely prominent except in corallites which become proliferous.

Pacific Ocean: Torres Straits; Great-Barrier Reef.

- | | | |
|-----------------------------|---|--------|
| <i>a.</i> Thursday Island. | Saville-Kent Coll. 92. 6. 8. 202. (Horizontal.) | } Type |
| <i>b.</i> Low Woody Island. | Saville-Kent Coll. 29. 6. 8. 203. (Corymbose.) | |

105. *Madrepora bifaria*. (Plate XXX. fig. A.)

Madrepora bifaria, Brook, Ann. Mag. N. H. 1892, vol. x. p. 453.

Corallum horizontal, with numerous erect spiciform branchlets on the under surface similar to those above. Colony 30 cm. long, 23 cm. broad, and 12 cm. thick. Main

branches 2 cm. thick, giving rise to subparallel divisions over 1.5 cm. diameter, each of which bears a series of branchlets on its outer surface. Branchlets simple, bi- or trifid, arising obliquely, but arched near the base so that the distal part extends vertically, length 3 to 4.5 cm., diameter 7 or 8 mm. near the base, slowly tapering, apices about 1.5 cm. apart, but many are divided near the apex. Axial corallites 2 mm. diameter, usually not over 1 mm. exsert; wall very porous, margin plane, star very well developed. Radial corallites half-tubular, labellate, or tubular with an oblique apex; the form varies with the greater or less development of the inner part of the wall; the majority arise at an angle of about 45°; length on the distal parts 2 to 3.5 mm., diameter across the lip about 2 mm.; those situated below the middle of a branchlet are short tubular, with a round aperture; immersed corallites do not usually occur on the branchlets, and on the main divisions they are small. The branchlets on the under surface are practically identical with those above, but many are only 2.6 cm. long, though others may be 4.5 cm. The primary septa are very well developed in nearly all cases, and the directives often nearly meet in the middle line; the second cycle may also be well developed. Corallum rather porous, surface spongy echinulate; wall thin and fenestrated at first, with increase in thickness the striæ become replaced by echinulations in longitudinal rows.

Java.

a. Java.

Purchased. 59. 12. 12. 2. (Type.)

106. *Madrepora patula*. (Plate IX. fig. E.)

Madrepora patula, Brook, Ann. Mag. N. H. 1892, vol. x. p. 460.

Corallum broad, depressed, bushy from a short simple stem, hemispherical; 29 cm. broad, 10 cm. high. Branches radiating, 1.4 cm. diameter, dividing two or three times in the same plane. Branchlets on the upper surface erect, spiciform, simple or divided near the base into two or more subparallel divisions, the distal portions of which are simple or further subdivided; length 2 to 4.5 cm., diameter at the base 6 to 7 mm. if simple, gradually tapering; apices about 1.4 cm. apart. Axial corallites cylindrical, 2 mm. diameter, 2 mm. exsert; wall a little thickened but very porous, margin plane. Radial corallites chiefly nariform, outer part of the wall at an angle of about 45°, remaining more or less prominent quite to the base of the branchlets; a few have the outer part of the wall more elongate and labellate; length 2 mm., rarely 3 mm., diameter 1.2 to 1.5 mm.; wall usually thin and fragile, but may be a little thickened near the base of the branchlets. Immersed corallites on the upper surface of the corallum distant, 1 mm. diameter. Star imperfectly developed, usually only the directive septa are recognizable in the prominent corallites; but near the base of the branchlets, in subimmersed cells, a second cycle of septa is usually present, and the directives may be very broad. Branchlets on the under surface 8 to 16 mm. long and about 4 mm. diameter, tapering to an axial corallite rarely more than 1.5 mm. exsert. Radial corallites chiefly forming sub-immersed dilatations, but a few are nariform and a few which indicate new outgrowths are

tubular, 4 mm. long. Corallum very porous; surface reticulate, finely echinulate; wall fragile, striato-reticulate.

Pacific Ocean: Great-Barrier Reef area.

a. Port Denison.

[Saville-Kent Coll. 96. 6. 8. 274. (Type.)

107. *Madrepora latistella*. (Plate IX. fig. B.)

Madrepora latistella, Brook, Ann. Mag. N. H. 1892, vol. x. p. 459.

Corallum subhorizontal, without fusions. Branches 9 to 10 mm. diameter. Branchlets on the upper surface erect, spiciform, simple or in groups of 2 to 3 from a common base, rarely proliferous except near the margin of the colony; length 2.5 to 3 cm., diameter 5 mm. Axial corallites cylindrical, 2.5 to 3 mm. diameter, 2 mm. exsert. Radial corallites chiefly gutter-shaped or labellate, usually ascending; wall of moderate length, but becoming reduced to a crescentic rim near the base of the branchlets; length 1.5 to 2 mm., diameter 1.3 mm.; on the marginal branches the corallites are stouter, further apart, and many which are tubular or subtubular indicate new proliferations, those which are 4 or 5 mm. long already bear several small buds. Star well-developed; even in corallites situated near the apex of a branchlet the primary septa are very prominent and a second cycle exists in rudiment; lower down the second cycle is also well-developed. Immersed corallites are numerous on the upper surface, and extend to the basal parts of the branchlets. On the under surface the branchlets extend obliquely, and often bear several elongate tubular corallites 6 mm. or more long and 2 mm. diameter. Corallum moderately porous; surface strongly striato-echinulate; wall strongly striate, echinulate at the base.

The species bears a close general resemblance to *M. patula*, but differs in the form of the corallites, in the importance of the septa, in the condition of the surface, as well as in minor points.

Pacific Ocean: Great-Barrier Reef area.

a. Port Denison.

Saville-Kent Coll. 92. 6. 8. 275. } Types.

b. Thursday Island.

Saville-Kent Coll. 92. 6. 8. 316. }

The following species are also provisionally referred to this subgenus. The first shows an affinity to the subgenus *Conocyathus*, the others are apparently related to *Lepidocyathus*:—

108. *Madrepora polystoma*. (Plate XIX. fig. A.)

Madrepora polystoma, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 466.

Corallum corymbose and complanate below, 35 cm. wide and 12 cm. high, closely resembling that of *M. concinna* in habit. Branches complanate below, the basal parts fused into a solid plate with immersed corallites; distal parts with hemicytoid corallites on the under surface and a few lateral, tubular or conical ones. Branches on the upper surface about 4 cm. long and 1.3 to 1.5 cm. thick, angular below, with crowded immersed corallites;

often divided above into two or four branchlets, many of which, especially near the centre of the corallum, bear numerous ascending proliferations. Axial corallites 2.5 to 3 mm. diameter, rarely more than 1 mm. exsert, margin scarcely rounded. The central branchlets bear crowded proliferations, 7 mm. long and 4 mm. thick, with crowded immersed corallites between; others are dimidiate and appressed, 2.5 to 4 mm. long and 1.5 mm. thick; wall thin but firm. The peripheral branchlets have few proliferous corallites; most are subequal, nariform with an elongate lip, and a little compressed, 3 mm. long and 1.3 mm. thick. Star moderately prominent, the directive septa very broad. Corallum rather porous; surface finely echinulate; wall striato-echinulate.

Mauritius.

a. Mauritius.

Purchased. 78. 2. 4. 6. (Type.)

109. *Madrepora indica*. (Plate XXXIV. fig. A.)

Corallum cespitose, subcorymbose, or consisting of a cluster of slender suberect branches from an oblique base. Diameter of the colony about 17 cm., height 14 cm. The base may be broad or narrow. Branches over 1 cm. diameter near the base, divided into two or more branchlets often at about the same point, each again forked and often proliferous near the apex; distal divisions 2 to 4 cm. long and 6 mm. thick, but the thickness is variable—in one specimen only 5 mm., in another a few of the branchlets are 10 mm. in diameter. Axial corallites cylindrical, 2 to 2.5, rarely 3 mm. diameter; primary septa equal and well developed; in corallites of 3 mm. diameter a narrow second cycle is also present. The radial corallites are nearly all immersed except on the distal divisions, and sometimes also on the basal parts of these; the prominent corallites are crowded, more or less appressed, nariform, half-tubular or sublabellate, somewhat compressed near the apex of a branchlet, becoming short, firm-walled, and more open below. Stouter branched specimens have the corallite wall thicker than in other cases, and many of the smaller corallites between them have a spiniform wall. In one specimen the corallites are mostly of one type; in another, with slender branchlets, some of the corallites remain more or less prominent nearly to the base of the branchlets. In the prominent corallites the septa are imperfectly developed; usually only the directives are recognizable, and the outer one is a little broader than the inner. In the immersed corallites the primary septa are narrow and subequal, but the directives are stouter than the others; sometimes a more or less complete second cycle is present. Corallum porous; surface covered with spinose plates; wall usually fragile, strongly striate, echinulate at the base.

Indian Ocean.

a-c. Ramesvaram.

Madras Mus. 88. 11. 25. 13; 93. 4. 7. 138 & 139. (Types.)

110. *Madrepora sinensis*. (Plate XXXIII. fig. C.)

Corallum incrusting, with numerous short slender branchlets on the upper surface, arranged singly or in groups; marginal divisions oblique, with branchlets only on the upper surface (subcorymbose); branchlets 1.5 to 2.5 cm. long and 5 to 6 mm. diameter at the base, the distal parts tapering. Axial corallites cylindrical, 1.3 to 2 mm. diameter; wall usually thin; primary septa equal and well developed, the directives stouter; a second cycle is also present. Radial corallites usually open nariform, but varying from short subimmersed to sublabellate or spreading scale-like, as in typical *Lepidocyathus*. The angle is consequently very variable; at first the corallites are ascending and irregular, the labellate ones are more spreading, and the few which are scale-like extend almost horizontally. The longest corallites measure 2 mm., and the diameter is usually 1.3 or slightly over, but the scale-like corallites may measure 2 mm. across the lip. The condition of the septa varies according to the form of the corallite. In those which are nariform or tubo-nariform the directive septa are equal and well developed, the other primaries narrower. In the labellate and scale-like forms the outer directive is more prominent than the inner, and in such cases the second cycle of septa is represented but is not complete. The corallum is porous, the surface dense and echinulate or provided with rows of echinulate plates; wall striato-echinulate. This species occupies an intermediate position between the *M. spicifera* group and typical *Lepidocyathus*, and combines in the form of its corallites the characters of both groups. In habit the species resembles *M. tumida*, Verrill.

Pacific Ocean: Formosa, China.

a, b. Formosa.

Consul Swinhoe [P.]. 70. 5. 9. 11 & 12. } Types.

c. China (probably South).

Fisheries Exhibition [P.]. 84. 2. 26. 23. }

111. *Madrepora frondosa*. (Plate XXXIV. fig. E.)

Corallum extending horizontally or ? vasiform, bearing a general resemblance to *M. subulata* in habit. Branches 1 cm. thick, about 1.5 cm. from centre to centre, arranged in more than one row, but often quite irregular and fused together at intervals. Under surface of the main branches not flattened, covered chiefly with immersed or subimmersed corallites, and provided at intervals with a few spreading nariform corallites in which the outer part of the wall is thickened, and also with a few short oblique twigs or proliferous corallites up to 8 mm. in length. Branchlets on the upper surface simple or forked, 2 to 5 cm. long and 6 or 7 mm. thick; most of them are rendered rough by the presence of proliferous corallites and many of the apices are divided. Axial corallites cylindrical, 2 to 2.5 mm. diameter and 1 to 2 mm. exsert; the wall is porous and strongly ribbed and echinulate; the aperture is somewhat funnel-shaped, and discloses a star of six moderate and subequal primary septa, together with a narrow second cycle; a few which are 3 mm. diameter have the second cycle of septa well developed. The prominent radial corallites are

unequal in length, half-tubular or gutter-shaped, with a convex apex; length 1.5 to 2.2, rarely 3 mm., diameter 1.5 mm.; the wall is a little thickened, but very porous and strongly tabulato-echinulate; a few are thin-walled and scale-like. The angle of the radial corallites varies from 40° to 80°, but is not usually over 60°. The septa are scarcely developed in the prominent radial corallites, usually only the directive septa are recognizable; in the immersed ones the septa vary from this condition through a stage in which all the members of the primary cycle are present with the outer directive most prominent, to one in which the six primary septa are all moderately developed but equal. The surface of the corallum in the older parts is closely vermiculate and echinulate.

The habitat of the type specimen is not recorded.

a. — ?

— ? 93. 4. 7. 90. (Type.)

112. *Madrepora elegantula*.

Madrepora elegantula, Ortmann, Zool. JB. 1889, Bd. iv. p. 507, pl. xii. fig. 5.

Corallum irregularly cespitose, with divided and proliferous branches, tapering above. The marginal branches are somewhat horizontal and flattened, with few corallites on the under surface. Axial corallites cylindrical and thin-walled, 1.5 to 2 mm. diameter, frequently 3 to 5 mm. exsert; the star may consist of 12 or only 6 septa; the primaries are very broad and nearly meet in the middle line. The radial corallites are chiefly appressed tubular, with the inner part of the wall scarcely free when short, in other cases the shape is bursiform or nari-form with a circular aperture 1 mm. or more in diameter; length 4 to 8 mm., diameter 2 mm., none are immersed except towards the base of the branches. Numerous tubular proliferous corallites occur between the others, forming incipient branchlets. The star of the radial corallites consists usually of twelve very narrow septa, the directives scarcely broader than the others. Corallum porous; surface vermiculate; wall thin, openly striate and echinulate.

The position of this species is uncertain, but it appears more closely related to *M. africana* than to any other species.

Indian Ocean: Ceylon.

a. Ceylon.

Haeckel Coll. 92. 12. 5. 18.

4. Subgenus LEPIDOCYATHUS.

Corallum usually corymbose or prostrate; in one species the colony is incrusting, with low mammiform elevations in place of proper branches. The branches are terete and usually scarcely tapering. Axial corallites similar to those of *Polystachys*; they are provided with twelve septa; the directives are usually slightly broader than the others. The radial corallites are evenly distributed, scale-like, very spreading, giving a catkin-like appearance to the branchlets. Sometimes there is a marked difference in size or angle between the

corallites of the central branchlets and those of the marginal ones. The septa are not well developed in the radial corallites, usually only the directives are recognizable, unless in immersed corallites, and the outer directive septum is generally either broader or stouter than the inner one.

A. *Corallum corymbose or bushy. The radial corallites thin-walled and prominent nearly to the bases of the branchlets.*

113. *Madrepora imbricata.*

Heteropora imbricata, Ehrenberg, Corallenth. d. roth. Meeres, p. 112; Dana, Zoophytes, p. 722.

The type specimen consists of several fragments which apparently form part of a vase-form colony. The main branches are not much fused together, and on the under surface bear elongate, appressed, tubular twigs, often 2 cm. long and only 3 mm. thick at the base, provided with lateral subimmersed buds. The branches on the upper surface are 8 to 10 mm. thick, and give rise to ascending branchlets 3 to 4 cm. long and about 6 mm. thick near the base. Axial corallites 1.5 to 2 mm. diameter, 1 mm. exsert, wall a little thickened, primary septa moderately developed. Radial corallites crowded, broad, flattened labellate, spreading, but not at right angles, equal or subequal, 2 mm. long and often 2 mm. broad across the lip, becoming shorter and subimmersed on the stouter parts. Star of the radial corallites not developed, frequently only the lower directive septum is recognizable. Corallum moderately porous but vitreous; surface dense, echinulate; wall striate and echinulate.

This species appears to have been overlooked and is not included in the work of Milne-Edwards. It differs chiefly from *M. millepora* and *M. convexa* in the less coalescent branches and the condition of the under surface.

Habitat not recorded. (*Berlin Museum.*)

114. *Madrepora millepora.*

Heteropora millepora, Ehrenberg, Corallenth. d. roth. Meeres, p. 109.

Madrepora millepora, Studer, MB. Akad. Wiss. Berlin, 1878, p. 528; Studer, Mitth. natur. Ges. Bern, 1880, p. 20; Ortmann, Zool. JB. 1889, Bd. iv. p. 508.

Non *Madrepora millepora*, Dana, Zoophytes, p. 446, pl. xxxiii. fig. 2; ? M.-Edwards & Haime, Coralliaires, t. iii. p. 155; ? Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Quelch, 'Challenger' Reef Corals, p. 157.

? *Madrepora convexa*, Ortmann, Zool. JB. 1888, Bd. iii. p. 153 (part.); *ibid.* 1889, Bd. iv. p. 508.

Corallum corymbose and pedicellate, flattened below, where the branches are confluent and bear immersed corallites and a few appressed or spreading conical twigs. In Ehrenberg's type the lateral branches of the colony are not preserved. The branchlets on the upper surface are terete, 5 to 7.5 cm. long and about 7 mm. diameter, simple or more usually subdivided into clusters, especially near the margin of a colony. The distal divisions are 2 to 4 cm. long, only slightly tapering, with the apices obtuse. Axial corallites cylindrical, 2 mm.

diameter and 1 mm. exsert in the type specimen; wall firm but not very thick, the aperture usually wide. Radial corallites spreading, imbricate, crowded, with the walls in contact in some specimens but free in others; they are gutter-shaped, thin-walled, and usually extend almost at right angles. In the type specimen the length is 1.25 mm., the breadth at the apex 1.75 to 2 mm. In other specimens the length may be 1.5 mm. or slightly over, and the diameter 2 to 2.3 mm. The radial corallites gradually become reduced in length until towards the base of the branchlets all are immersed. On the marginal branchlets the corallites are more spreading and are not quite so crowded. Corallum porous, surface reticulato-echinulate, wall striato-echinulate. In Studer's 'Gazelle' specimens the axial corallites are usually 2.5 to 3 mm. thick, and the under surface of the corallum bears numerous spreading conical twigs. A fine series of specimens form part of the Saville-Kent Collection, which exhibit considerable variation. Some agree closely with Studer's specimens, others have more distant and more distinctly open radial corallites; in some the corallites of the more central branchlets are distinctly ascending, but in others there is scarcely any difference in the angle of the corallites of the middle and the peripheral divisions. The axial corallites are provided with 12 well-developed septa; the directives are slightly broader than the other primaries. In the radial corallites often only the directive septa are recognizable, the outer one rather stouter and sometimes broader than the inner. In older corallites the star consists of a primary series of septa and a more or less complete second cycle; all are very narrow, but the outer directive is a little more marked.

Var. *compacta*.

This name is proposed for a variety which recalls the appearance of *M. hebes*, but the habit is not fruticose as in that species. The branchlets are usually shorter, stouter, and more crowded than in typical specimens, and the colony is either prostrate or forms small compact corymbose clumps. The radial corallites are short with a thickened base, and thus resemble those of some specimens of *M. hebes* rather than typical *M. millepora*, but the condition of the septa is the same as in typical *M. millepora*.

Probably the species described and figured by Dana as *M. millepora* is distinct from Ehrenberg's species. Unfortunately his type specimen does not appear to be preserved in the National Collection at Washington. The figure shows a much more open reticulum than occurs in the Berlin specimens, and, what is perhaps of more importance, the radial corallites of the central branchlets are much smaller, more crowded, and much less spreading than those of the marginal divisions. I have regarded it as synonymous with my *M. squamosa*. Apparently M.-Edwards and Verrill have followed Dana in the identification of *M. millepora*, Ehrb., but this is not certain. On the other hand, *M. convexa*, Dana, approaches *M. millepora*, Ehrb., and may prove to be a variety of it. The points of difference are noted under the heading *M. convexa*. I am inclined to refer some of the specimens studied by Ortmann to *M. millepora* rather than to *M. convexa*, but one of them (Indian Ocean, Conrad) comes nearer to var. *compacta* than the type. The branchlets are 8 to 10 mm. thick, and the radial corallites are very short, broad, open labellate, and imbricate, 2.5 to

3 mm. diameter, not over 2 mm. long, and usually less. The aperture is very wide and the septa very prominent. Wall closely striate.

Indo-Pacific Ocean : Ceylon, Singapore, Great-Barrier Reef area.

<i>a-o.</i> Cleremont Island.	Saville-Kent Coll.	92. 6. 8. 165 to 178 & 186.
<i>p.</i> Port Denison.	Saville-Kent Coll.	92. 6. 8. 179.
<i>? q.</i> Low Woody Island.	Saville-Kent Coll.	92. 6. 8. 180.
<i>? r-t.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 181, 183 & 184.
<i>u.</i> Thursday Island.	Saville-Kent Coll.	92. 6. 8. 182.
<i>v.</i> Green Island.	Saville-Kent Coll.	92. 6. 8. 266.
<i>w.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 267.
<i>x.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 268.
<i>y.</i> Ceylon.	Haeckel Coll.	92. 12. 5. 30.

Var. *compacta*.

<i>a-g.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 128 to 134.
<i>h.</i> Cleremont Island.	Saville-Kent Coll.	92. 6. 8. 185.
<i>i-l.</i> Capricorn Islands.	Saville-Kent Coll.	92. 6. 8. 190 to 192 & 263.

115. *Madrepora convexa*.

Madrepora convexa, Dana, Zoophytes, p. 449 ; M.-Edwards & Haime, Coralliaires, t. iii. p. 158 ; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42 ; Studer, MB. Mitth. naturf. Ges. Bern, 1880, p. 20 ; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15 ; Ortmann, Zool. JB. 1888, Bd. iii. p. 153 ; ibid. 1889, Bd. iv. p. 508 (part.).

? *Madrepora corymbosa*, Verrill (*non* Dana), Bull. Mus. Comp. Zool. 1864, vol. i. p. 42.

Corallum low corymbose, upper surface flattened or convex, 25 cm. or more in diameter. Main branches nearly horizontal, complanate below, reticulato-coalescent, with a few short, naked and subangular branchlets in the general plane. Corallites on the under surface all immersed or subimmersed excepting at the margin of the colony, or in some specimens with a few scattered, thick, bursiform or appressed tubular ones. Branchlets on the upper surface simple or subsimple and terete near the centre of the colony, more divided or proliferous near the margin, 5 to 7 mm. thick and 2.5 to 6 cm. long, varying in different specimens, mostly tapering, apex not very obtuse. Axial corallites short, cylindrical, 1 to 2 mm. thick and 1 mm. exsert, wall very porous and a little thickened. Radial corallites equal, scale-like or labellate, crowded, and spreading almost at right angles, with a broad or rather narrow flattened fragile lip, 1.5 mm. long and 1 to 2 mm. broad. Septa in two cycles, both well developed in the axial corallites ; in the radial ones the second cycle is rudimentary but rarely absent. Cœnenchyma very porous ; wall delicate, striato-echinulate.

A cespitose specimen 18 cm. in diameter, from Tongatabu, differs only in habit and in the more proliferous branchlets and slightly unequal corallites.

This species is distinguished from *M. millepora* by the shorter, more simple, and tapering

branches, rarely proliferous except at the margin of the colony, where the corallites are more elongate and irregular. The radial corallites have typically a flattened, not a gutter-shaped lip, but the latter form is also present, more distinctly marked in some specimens than in others; the septa are also better developed.

Indo-Pacific Ocean : Singapore, Great Barrier Reef area, Tongatabu.

<i>a, b.</i> —?	Dr. Mantell's Coll. 41. 1. 13. 12 & 15.
<i>c.</i> Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 10.
<i>d.</i> Singapore.	J. P. Davies, Esq. [P.]. 82. 9. 25. 3.
<i>e.</i> —?	Purchased. 40. 5. 15. 12.
<i>f, g.</i> —?	—? 93. 4. 7. 106 & 107.
<i>h.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 164.

116. *Madrepora prostrata*.

Madrepora prostrata, Dana, Zoophytes, p. 447, pl. xxxiii. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 156; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18; ? Ortmann, Zool. JB. 1888, Bd. iii. p. 153; *ibid.* 1889, Band iv. p. 508 (*non* Quelch, 'Challenger' Reef Corals, p. 163; *non* Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454).

Corallum prostrate, spreading horizontally from a lateral attachment. Branches remotely coalescing, not flattened below, with few branchlets and the corallites all immersed. On the upper surface the branches are cylindrical, nearly simple, 6 mm. thick, blunt at the apex. Axial corallites short, about 1.5 mm. broad. Radial corallites crowded, spreading nearly at right angles, labellate, with broad, much flattened lip. Star distinct, the directive septa broadest. (*Dana*.)

The specimen from Fiji recorded by Ortmann differs from the above description of *Dana* in several respects and may prove to be distinct. The under surface is flattened, and the branches fused together and provided with a few conical twigs and pustules without aperture and also a few immersed corallites. The branchlets on the upper surface do not exceed 1.8 cm. in length, and are frequently 1 cm. thick at the base, tapering, but with a blunt apex. Axial corallites 2 to 2.5 mm. broad, scarcely exsert. Radial corallites very short, spreading, bursiform, with the wall a little thickened; lip not elongate, nearly 2 mm. diameter. Star prominent.

The form from the Great-Barrier Reef does not altogether agree with *Dana*'s description, and looks in some respects like a diminutive form of *M. millepora*. The corallum is open corymbose, flattened above and oblique at the sides, but with very few fusions, or forms flattened, plate-like masses with short branchlets on the upper surface. In the latter case the corallum is 3.3 cm. thick, the main branches confluent and in parts almost solid. The branchlets are simple, or 2 to 5 arise from a common base from the upper surface of a branch; length 2.5 to 3.2 cm., diameter 7 mm. Corallites similar to those of *M. millepora*, but smaller, length 1 to 1.5 mm., diameter 1.5 to 2 mm.

Pacific Ocean : Fiji, Sulu Sea, Great-Barrier Reef.

<i>a-d.</i> Capricorn Islands.	Saville-Kent Coll.	92. 6. 8. 187, 188, 194, & 262.
<i>e.</i> Thursday Island.	Saville-Kent Coll.	92. 6. 8. 193.
<i>f.</i> Low Woody Island.	Saville-Kent Coll.	92. 6. 8. 195.

117. *Madrepora squamosa*. (Plate XX. fig. B.)

? *Madrepora millepora*, Dana (*non* Ehrenberg), Zoophytes, p. 446, pl. xxxiii. fig. 2.

Madrepora squamosa, Brook, Ann. Mag. N. H. 1892, vol. x. p. 463.

Corallum corymbose, subvasiform, about 27 cm. diameter and 13 cm. high; branches rarely coalescent. Under surface oblique; branches 8 to 12 mm. diameter, not flattened, bearing numerous elongate twigs which extend horizontally, 1.5 to 3 cm. long, 6 mm. diameter near the base, terete and slowly tapering to a blunt apex; axial corallites scarcely prominent; radial corallites all immersed or subimmersed. Branches on the upper surface simple or subsimple near the centre of the corallum, but more divided near the periphery; the central ones are 4.5 cm. long, 8 mm. diameter near the base, 4 mm. near the apex, apices about 1.8 cm. apart. Axial corallites cylindrical, 2.5 to 3.5 mm. diameter, 1.5 mm. exsert, wall thick, star very well marked, the directive septa rarely more prominent than the others. Radial corallites of the central branches equal, small, labellate, with rounded lip, spreading almost at right angles, rarely over 1 mm. diameter and 0.75 mm. long, but becoming wider and subimmersed towards the base of the branches. On the marginal branches the corallites are much larger and more distant; usually 2 mm. diameter, 2 mm. long, and the lips are nearly 2 mm. apart; near the apex of the twigs the corallites are scarcely so spreading as in the other parts, and the form is usually flattened labellate. Corallum porous; surface reticulate and echinulate; wall fragile, fenestrated. The star consists of 6 moderately developed septa in the corallites of the outer branches, but the directives, and particularly the lower one, are more prominent and thicker than the others; in the corallites of the central branches the star is quite indistinct, often only the lower directive septum is recognizable.

This species appears to agree closely with Dana's figure of *M. millepora*, which is probably not the species described by Ehrenberg. The contrast between the size of the radial corallites on the central as compared with the peripheral branches is more marked than in any other species which has come under my notice.

Pacific Ocean: Great-Barrier Reef, East Indies (*Dana*).

<i>a, b.</i> Cleremont Island.	Saville-Kent Coll.	92. 6. 8. 163 & 196.	} Types.
<i>c.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 189.	

118. *Madrepora subulata*.

Madrepora subulata, Dana, Zoophytes, p. 448, pl. xxxii. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 155; Studer, MB. Akad. Wiss. Berlin, 1878, p. 527; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

Corallum pedicellate and prostrate, plane above; branches 12 to 15 mm. thick, loosely intricate, and remotely coalescent, not flattened. On the under surface the branchlets are

few, nearly naked, and appressed into the plane of the frond, and bear numerous immersed or subimmersed corallites. Branchlets of the upper surface terete, subulate, subacute, 4 to 6.5 cm. long and 5 or 6 mm. thick, gradually tapering. Axial corallites 1.5 to 2 mm. broad, rarely over 1 mm. exsert. Radial corallites usually labellate, but often spreading, short, or scarcely prominent, 1.5 to 2 mm. diameter, rarely over 1.5 mm. long, wall thin, striato-echinulate; those of the marginal branches more spreading and somewhat larger. The corallites become shorter below, and many have a moderately thick ligulate border; at the base they are often all immersed or subimmersed. Surface echinulate. Star not very distinct; the directive septa thick and prominent, but the others delicate and often rudimentary.

The species resembles *M. convexa*, but differs in the much less coalescent and not flattened branches, the more elongate, slender, and acuminate branchlets, and the radial corallites are shorter and less spreading, and the star is not so conspicuous.

East Indies; Singapore; New Guinea.

a. Singapore.	Dr. Schneider [P.]. 78. 6. 6. 3.
? b. — ?	Mrs. J. P. G. Smith [P.]. 45. 6. 6.
c. — ?	— ? 93. 4. 7. 123.

119. *Madrepora spathulata*. (Plate XXXII. fig. B.)

Madrepora spathulata, Brook, Ann. Mag. N. H. 1891, vol. viii, p. 469.

Corallum prostrate, complanate below. Branches 1.5 cm. thick, flattened on the under surface, with numerous immersed and short nariform corallites, and a few spreading tubular ones between; branchlets in the general plane with one or several tubular corallites near the apex, often 5 mm. long and 2 mm. thick. Branches on the upper surface arcuate, 7 cm. long, and usually consisting of two branches fused together, so as to be somewhat oval in section, diameter 1.8 by 1 cm.; each division is about 1 cm. thick up to within 1 cm. of the apex and then becomes divided into two or four branchlets, most of which are again imperfectly divided into two; apices blunt. Axial corallites 2 to 2.5 mm. thick, scarcely exsert; wall thick and very porous; aperture usually small, but sometimes funnel-shaped. Radial corallites crowded, spreading at right angles, 2 mm. broad and 2 mm. long in the upper parts, chiefly spathulate, with a rounded lip which is sometimes recurved; at a lower level the wall is a little thickened and not so prominent, and at the base of the branchlets the corallites are all subimmersed or immersed, with an aperture of nearly 1 mm., but the cells occurring in lines of fusion are smaller. Star indistinct, only the directive septa recognizable. Corallum very porous; surface reticulate and echinulate; wall fragile, striato-reticulate, becoming echinulate later.

Solomon Islands.

a. Treasury Island, Solomon Islands.	Dr. Guppy [P.]. 84. 12. 11. 25. (Type.)
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120. *Madrepora selago*.

Madrepora selago, Studer, MB. Akad. Wiss. Berlin, 1878, p. 527, pl. i. fig. 2; Ortmann, Zool. JB. 1889, Bd. iv. p. 507.

Corallum pedicellate? Branches extending horizontally, rarely coalescent, 8 to 10 mm. thick. The under surface is provided with numerous, somewhat appressed, conical twigs with appressed or tubiform corallites; surface covered with rows of delicate echinulations. Branchlets on the upper surface arched, tapering, not over 4 cm. long, and only 3 to 4 mm. thick; they arise singly or in groups of two or three from a common base. Axial corallites cylindrical, 1 mm., rarely 1.5 mm. exsert, and 1 to 1.5 mm. diameter. Radial corallites crowded, delicate, and gutter-shaped, rather broader at the apex, with a convex margin; they arise at an angle of about 35° ; the average length is 1 mm., and the diameter 1.5 mm. across the lip, those near the apex are a little longer, and the lip gradually becomes reduced towards the base of a branchlet; on the main divisions the corallites are immersed, excepting on the upper surface of the branches. The star consists of 6 septa, which have a breadth equal to about half the radius of the calicle. The corallite-wall is fenestrated, the longitudinal striæ becoming converted into series of echinulations at the base. Studer's figure 2*b* does not give a correct representation of the radial corallites; they are not so large as figured, and are not cylindrical but gutter-shaped or spatulate with a broader convex apex as already stated.

A specimen which forms part of the Saville-Kent Collection appears referable to this species, but differs from the type in several respects. It agrees generally with the revised description given above, and forms a flat horizontal growth 7.5 cm. thick. The branchlets are a little stouter than in the type (5 or 6 mm.), and the main horizontal branches are a little confluent so as to form an open reticulum. The radial corallites are immersed or subimmersed on all parts excepting the distal 2 or 3 cm. of the branchlets, where they are irregular, spreading, flattened-labellate, not over 2 mm. long, and usually slightly over 1.5 mm. diameter. The axial corallites are 2 mm. diameter. The star consists usually of 6 septa, the directives being slightly broader than the others; sometimes only the directives are present, in other cases, especially in the older corallites, a narrow second cycle may be present.

A specimen from Ceylon in the Jena Museum has thicker-walled corallites than usual, and has been named var. *robusta* by Ortmann. In this specimen the diameter of the axial corallites is 2 to 2.25 mm., not 1 mm. as recorded in Ortmann's paper. The lip of the radial corallites is thin in those situated near the apex of the branchlets, but in those below becomes thickened and finally wart-like or immersed.

Pacific Ocean: New Hanover, Galewo Straits, Great-Barrier Reef, Torres Straits, Ceylon.

<i>a.</i> Flat-top Island, near Marburg.	Saville-Kent Coll. 92. 6. 8. 201.
<i>b.</i> Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 315.
? <i>c.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 295.

121. *Madrepora cribripora*.

Madrepora cribripora, Dana, Zoophytes, p. 470, pl. 31. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 137; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15; ?Duncan, Journ. Linn. Soc. Lond. 1886, vol. xxi. p. 20 (*non* Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 452).

Arborescent or cespito-arborescent, spreading ramose; branches neatly terete, 8 to 10 mm. thick; branchlets long (some 7.5 cm.), attenuate and subacute. Corallum scabrous, very porous; axial corallites stout (2 to 3 mm.), quite long, striate; the radial ones very short, round-nariform, fragile, a little crowded; cell open; star obsolescent, one inner lamella prominent. (*Dana*.)

Three specimens in the collection from Tongatabu appear referable to this species, but differ in several points from the above description. The one which comes nearest to the type in habit (*a*) is a small cespito-arborescent clump about 14 cm. high and 19 cm. wide. The branches are 8 to 11 cm. long, and about 1 cm. thick, or slightly more, some are forked near the base, arcuate, and scarcely subdivided, others bear 3 to 7 branchlets. All are subterete, and taper rather rapidly to a prominent axial corallite, which is 2.5 to 3 mm. diameter and 3 mm. exsert. The radial corallites are wide, half-tubular or labellate, all spreading almost at right angles, 1.5 to 2 mm. wide or rather more, and 1 to 2 mm. long; wall thin, and strongly striato-reticulate and echinulate. A few which have a thick wall and almost circular aperture indicate new proliferations. All the corallites become shorter and finally immersed on the lower and under parts of the branches. The star consists of 12 narrow subequal septa in axial corallites; in the radial corallites there are only 6, and the inner directive is usually considerably broader than the others. Corallum very porous and fragile; surface reticulate and rather distantly but distinctly echinulate.

The other specimens (*b* and *c*) consist of single branches of a variety which is evidently arborescent rather than cespitose in habit. Branches 20 to 25 cm. long, sinuous, 1 cm. thick, very gradually tapering, laxly and spreadingly divided; branchlets 3 to 8.5 cm. long, spreading, simple or subsimple, nearly as thick as the branch from which they rise. In the upper branchlets the corallites resemble those already described, but they are subequal, nearly 2 mm. long; shorter or subimmersed ones are of rare occurrence. The lower and usually shorter branchlets differ entirely from the above description. The axial corallites are 2.5 to 3 mm. diameter, but scarcely exsert, in no case over 1.3 mm.; cup open, with 12 septa. Radial corallites all very short, round nariform with a curved and relatively thick and firm wall, 2 mm. diameter and about 1 mm. long; wall strongly and rather distantly echinulate, sometimes substriate. In the Palm-Island specimen one of the axial corallites contains 24 septa.

Dana's specimens were obtained on a reef near Rewa (Viti Levu), where the waters are much freshened by the river which empties near, and this was almost the only species occurring on that part of the reef.

Indo-Pacific Ocean: Tongatabu, Fiji, Great-Barrier Reef, ? Mergui Archipelago.

<i>a</i> . Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 1.
<i>b-c</i> . Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 2 & 3. (Var.)
<i>d</i> . — ?	— ? 41. 2. 23. 39.
<i>e</i> . Palm Island.	Saville-Kent Coll. 92. 6. 8. 299.

122. *Madrepora cuspidata*.

Madrepora cuspidata, Dana, Zoophytes, p. 485, pl. xlii. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 149; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15; Ortmann, Zool. JB. 1888, Bd. iii. p. 151.

Corallum subcespitose, consisting of a cluster of long cuspidate, regularly tapering, and nearly simple branches, 2.5 cm. thick and 5 to 15 cm. long, rising from a common solid base. Axial corallites probably 2.5 to 3 mm. diameter, 2 mm. exsert, and tapering a little towards the apex. Branches nearly bare of corallites on the inferior side, on the other the radial corallites are short sublabellate, erect, and fragile, with immersed corallites between; aperture about 0.7 mm. diameter, circular; the immersed cells are smaller. Star 6-rayed, distinct, the directive septa broadest. (*Dana*.)

The specimen recorded by Ortmann forms a cespitose clump 16 cm. high and 24 cm. broad from a base 8.5 cm. diameter. The central branches are erect and simple or sub-simple, dilated at the base, and rapidly tapering towards the apex, but the middle part is cylindrical; length 7 cm., diameter 2 cm. at the base. Marginal branches spreading sub-horizontally, 10 cm. long. Axial corallites cylindrical, 2 to 3 mm. diameter; the broader ones have a larger aperture and are sometimes 3 mm. exsert. The radial corallites are often shorter on the outer than on the inner side of the branches, but there is not in this specimen the marked difference shown in Dana's figure.

The main divisions are covered with small, crowded, immersed corallites; a little above the bases of the erect branches short tubular or half-tubular to sublabellate corallites occur scattered amongst the immersed ones, these are 1.5 to 1.75 mm. diameter and have the wall a little thickened. Nearer to the apex nearly all are more or less prominent, and extend at an angle of about 60°; the form is usually gutter-shaped, with a convex margin and thin fragile wall; the length varies from 0.5 to 3 mm., the diameter is not usually over 1.5 mm. The apices of the branches frequently bear proliferations from 7 to 10 mm. in length. The corallum is rather porous, the surface reticulate, and the wall striato-reticulate.

There is some uncertainty whether this specimen really belongs to *M. cuspidata*. The figure given by Dana does not lead one to suppose that this species belongs to the subgenus *Lepidocyathus*.

Pacific Ocean: Tahiti, Ponapé.

B. *Corallum variable in form. Radial corallites little prominent, excepting near the apex of the branchlets.*

123. *Madrepora rubra*.

Madrepora rubra, Studer, MB. Akad. Wiss. Berlin, 1878, p. 529, pl. ii. fig. 4.

Corallum subcorymbose from a broad incrusting base. Outer branches oblique, short, pointed, and proliferous, partly coalescing into an open network. Middle branches simple, slender, 6 cm. or more in length, and rarely over 5 mm. thick at the base, gradually tapering to an axial corallite 1.5 mm. broad and 1 mm. exsert. Radial corallites near the base of the branches immersed, or with a narrow half-ring shaped border, becoming more crowded

and gutter-shaped above, spreading at right angles, about 1.5 mm. broad and 1 mm. long; wall thin and fragile, except on some of the outer branchlets, where the corallites are more distant, of greater diameter, and have the wall considerably thickened and the margin rounded. Star rudimentary, often only the lower directive septum prominent. Corallum fragile; surface rather dense, subreticulate, and echinulate, often in linear series; wall striate and echinulate near the base.

The species occurs in shallow water in the neighbourhood of freshwater springs.

Pacific Ocean : Carteret Harbour, New Ireland (*Berlin Museum*).

124. *Madrepora exigua*.

Madrepora exigua, Dana, Zoophytes, p. 469, pl. xxxviii. fig. 2; Studer, MB. Akad. Wiss. Berlin, 1878, p. 533; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15.

Madrepora minima, Quelch, 'Challenger' Reef Corals, p. 157, pl. ix. fig. 4.

? *Madrepora millepora*, Quelch (*non Ehrenberg*), 'Challenger' Reef Corals, p. 157.

Corallum small, arborescent or subprostrate; branches slender, 4 to 6 mm. thick, with a few short spreading branchlets 1 to 4 cm. long, slowly tapering to a relatively large axial corallite, sometimes arcuate, and with occasional fusions between the branches. Axial corallites 2.5 mm. diameter, 1 mm. exsert, or a little more, with a thick porous wall. Primary septa well developed, subequal, second cycle little developed or wanting. Radial corallites very small, unequal, 0.5 to 1 mm. diameter, the majority fragile and scarcely prominent, quite immersed on the older parts; they are chiefly round-nariform, with a few of the more prominent ones labellate, 0 to 1 mm. long, aperture usually circular; directive septa well developed, the others narrow, second cycle absent or rudimentary. Corallum very porous; surface finely reticulate and echinulate; wall strongly striate, echinulate.

Studer observes that the species grows on pieces of dead coral, near low-water mark.

M. minima, Quelch, is subprostrate in habit, and the branches on coming in contact with a foreign body fuse with it and form an incrustation over it; in all other respects it agrees closely with Dana's description.

Pacific Ocean : Fiji, New Hebrides, Solomon Islands.

<i>a, b.</i> Api, New Hebrides.	H.M.S. 'Challenger.' 86. 12. 9. 223, & 85. 2. 1. 15. (Types of <i>M. exigua</i> , Quelch.)
? <i>c.</i> Api, New Hebrides.	H.M.S. 'Challenger.' 86. 12. 9. 221. (= <i>M. millepora</i> , Quelch.)
? <i>d.</i> — ?	— ? 93. 4. 7. 120.

125. *Madrepora mirabilis*.

Madrepora mirabilis, Quelch, 'Challenger' Reef Corals, p. 159, pl. x. fig. 5.

Corallum prostrate; branches originating laterally from a thick compressed elongate stem, and somewhat coalescent. Stem 4 cm. wide or more, tapering gradually. Under

surface almost destitute of branches, but the branchlets on the lateral and upper surfaces are very numerous; they are short, spike-shaped, and simple, 6 to 7 mm. thick at the base, rarely divided above. Axial corallites about 2.5 mm. wide, with very porous edges and very distinct star of 12 septa. In many axial cups small or rudimentary septa of a third cycle are present, and in a few of larger size they are large and well developed. Radial corallites very unequal and variable, about 1.5 mm. wide, immersed and distant on the under surface and over a large part of the upper surface, becoming verruciform at the base of the branchlets, and very short, open, round nariform above, where they are often crowded; star of 12 well-developed septa; in corallites which are not verruciform the directive septa are exsert. Cœnenchyma porous in the younger parts, becoming closely reticulate and dense below; surface roughly and closely echinulate; wall strongly striate. (*Quelch.*)

This remarkable species presents two characters which had not previously been observed in specimens of the genus, viz. exsert directive septa, and in certain corallites the presence of a third cycle of septa. I have since observed the latter character in several other species.

The following additional notes on the type specimen will be of interest:—The branchlets are oblique, 1 to 2 cm. long and up to 7 mm. thick at the base, distinctly tapering, the apices about 1 cm. apart. Axial corallites 2.5 to 3 mm. diameter, scarcely exsert; wall provided with broad plate-like striæ. Corallites on the under surface and on the main branches immersed and distant, 1.5 mm. diameter, star very prominent, the directive septa usually exsert; those near the base of the branchlets have usually a thick ligulate border and are 2 mm. in diameter; those nearer to the axial corallite have not such a thick wall and are tubular, at an angle of about 45°, many have the inner part of the wall not free, but in the more prominent ones (1.5 to 2 mm.) the inner part of the wall is quite distinct; wall very porous, and armed with dentate plates; surface of the cœnenchyma often tabulato-echinulate; septa very prominent in all except the younger corallites.

East Indies: Banda.

a. Banda.

H.M.S. 'Challenger.' 85. 2. 1. 14. (Type.)

C. Corallum variable. Radial corallites usually more or less crescent-shaped, thickened at the base, but generally thin at the margin.

126. *Madrepora studeri.* (Plate XXV.)

Madrepora surculosa, Studer (*non* Dana), Mitth. naturf. Ges. Bern, 1880, p. 20.

Madrepora convexa, Ortmann, Zool. JB. 1889, Bd. iv. p. 508 (part.).

Corallum cespitose or corymbose and pedicellate. The under surface is complanate in the corymbose form, the branches being fused into flattened alciform groups, with numerous immersed corallites and short thick tubular ones near the margin. On the pedicel, which in one specimen exists only on one side of the corallum, there are numerous short twigs, which spread horizontally and evidently represent the shorter marginal branches of the cespitose

form. Branchlets on the upper surface 2·5 to 7 cm. long and 8 mm. thick below. Axial corallites 2 to 2·5 mm. thick, 1 to 2 mm. exsert; aperture sometimes small, at others funnel-shaped. Radial corallites short, broad, and very spreading, crescent-shaped, crowded so as to give a serrate effect to the branchlets; wall thick at the base, but tapered towards the lip; 2·5 or even 3 mm. diameter and rarely over 1·5 mm. long, aperture wide. The star is very prominent, and usually consists of 12 septa; the primary series sometimes equal, at others only the directives are broad. Corallum porous and reticulate in section; surface reticulate and echinulate; wall striate, the striae dentate below.

One of the specimens in the Strassburg Museum referred by Ortmann to *M. convexa*, Dana, appears to belong here. It differs from the Berlin specimens chiefly in having longer and rather stouter branchlets on the upper surface (8 to 10 mm. thick).

In the British Museum specimens, one of which forms a corymbose and pedicellate clump, 34 cm. wide and 13 cm. high, the central branches are 7 cm. long and 1 cm. thick. The radial corallites are gutter-shaped, with a curved lip, and extend almost at right angles; the wall is often thickened, especially towards its base, length 2 to 3 mm., diameter 2 to 2·5 mm. A few immersed corallites occur between the prominent ones; the latter become more distant below, then ring-shaped, and finally immersed.

Singapore (*Berlin Museum*); Indian Ocean (*Strassburg Museum*).

a, b. — ?

— ? 93. 4. 7. 122 & 127. (Types.)

127. *Madrepora sarmentosa*. (Plate XXII.)

Madrepora sarmentosa, Brook, Ann. Mag. N. H. 1892, vol. x. p. 462.

Corallum flattened, bushy, extending obliquely, with crowded short branchlets on both upper and lower surfaces. Height 25 cm., breadth 32 cm., thickness about 7·5 cm. near the middle; base oval, incrusting, 17 cm. by 9 cm. Main branches 2 to 3 cm. thick, fused together so as to form a solid mass near the base, but free and closely divided near the apex of the colony. Surface both above and below covered with large immersed corallites, over 1 mm. diameter, with a star of 12 septa; sometimes the primary septa are well developed, at others narrow and subequal. The whole upper surface is studded with short, erect, and blunt twigs, simple or in groups of three or five from a common base, apices usually about 1·5 cm. apart. Near the base the twigs are usually under 1 cm. long and 5 to 7 mm. thick; more distally the length gradually increases to 2 cm., and the diameter to 8 or 10 mm., or more in the case of compound twigs. Axial corallites 3·5 to 4·5 mm. diameter, subhemispherical, wall thick and reticulate; aperture small, with a star of 12 septa, the directives most prominent. Radial corallites on the basal parts subimmersed and dilated; on the distal divisions swallow-nest shaped, broad nariform or sublabellate; the majority have the upper margin nearly at right angles to the axis of the twig; length 2 to 3·5 mm., diameter 2 to 3 mm., the outer part of the wall is usually thick and convex, especially in the sublabellate or half-tubular corallites, which have a broad apex; aperture large, with a star of 6 septa, which are not usually well developed and may sometimes be almost indistinguishable. The

branchlets on the under surface are similar to those on the upper, but scarcely so stout, and are usually distinctly tapering. The axial corallites are more slender (3 to 3·5 mm.), and may sometimes be 4 mm. exsert. Corallum porous, but vitreous; surface reticulate; wall strongly striate and echinulate.

Var. *a*.

Two small specimens from Rocky Island Reefs appear referable to this species, but differ in having thinner-walled corallites and more slender twigs.

Var. *β*.

Under surface almost without branchlets. Branchlets on upper surface very proliferous; margin of radial corallites oblique, *i. e.* outer part of wall not so prominent as in type. Wall sometimes thin.

This species approaches the subgenus *Tylopora* in the form and size of the axial corallites.

Pacific Ocean: Great-Barrier Reef area.

<i>a, b.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 228 & 229. (Types.)
<i>c, d.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 230 & 231. (Var. <i>α</i> .)
<i>e.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 232. (Var. <i>β</i> .)
<i>f.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 233. (Var. <i>β</i> .)
<i>g, h.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 311 & 312.

128. *Madrepora hebes*.

Madrepora hebes, Dana, Zoophytes, p. 468, pl. xxxv. fig. 5; M.-Edwards & Haime, Coralliaires, t. iii. p. 142; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Verrill, Proc. Essex Inst. 1865, vol. v. p. 20; *ibid.* 1869, vol. vi. p. 100; Duncan, Journ. Linn. Soc. Lond. 1886, vol. xxi. p. 19; Quelch, 'Challenger' Reef Corals, p. 155; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16.
? *Madrepora elliptica*, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 41, pl. iv. fig. 10.

Corallum fruticose or stunted arborescent, laxly divided, with stout spreading branches. Branches terete or subterete, 12 mm. thick, usually not over 7·5 cm. long, scarcely tapering, sometimes much and divaricately divided, apex quite obtuse and sometimes proliferous. Axial corallites 3 to 4 mm. or more in diameter; wall thick, slightly prominent. Radial corallites equal or subequal, very short and spreading, labellate or gutter-shaped, usually much crowded on the branches, their walls sometimes becoming fused together so as to obscure the *cœnenchyma*; lip 1·5 to 2·5 mm. (rarely 3 mm.) diameter, 1 mm. long, but sometimes a little unequal. Wall slightly thickened, but very fragile and porous, strongly striate. Septa well developed in the axial corallites; in the radial ones not destined to form buds the star is scarcely recognizable. Corallum porous; surface reticulate and echinulate.

Var. *labiosa*.

Branches sometimes 1·8 cm. diameter at a point not more than 3 cm. from apex. Apices of branches very proliferous. Axial corallites 5 mm. diameter and 1·5 mm. exsert;

wall very porous and flattened above. Radial corallites 2 mm. diameter or over, a little unequal, with immersed ones scattered between. Aperture large and usually circular. Sometimes the radial corallites are not so spreading as in the type form.

A small subprostrate specimen, from Fiji, agrees with the variety in the form of the radial corallites, but the axial corallites are smaller and agree with those of typical specimens.

Pacific Ocean : Fiji, Great-Barrier Reef, Torres Straits, Malacca.

<i>a.</i> Kandavu, Fiji.	H.M.S. 'Challenger.' 86. 12. 9. 224.
<i>b.</i> Fiji Reefs.	H.M.S. 'Challenger.' 86. 12. 9. 225.
<i>c.</i> ———?	——? 93. 4. 7. 161.
<i>d.</i> Capricorn Islands.	J. B. Jukes, Esq. [P.]. 46. 7. 30. 31.
<i>e-l.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 1 to 8.
<i>m, n.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 17 & 18.
<i>o.</i> Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 19.
<i>p, q.</i> Warrior Island.	Saville-Kent Coll. 92. 6. 8. 21 & 22.
<i>r.</i> Green Island.	Saville-Kent Coll. 92. 6. 8. 23.

Var. *labiosa*.

<i>a-g.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 9 to 11 & 13 to 16.
<i>h.</i> Green Island.	Saville-Kent Coll. 92. 6. 8. 12.
<i>i.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 20.
<i>j, k.</i> Straits of Malacca, 17 fathoms.	Sir E. Belcher [P.]. 42. 12. 2. 86, & 42. 11. 28. 2.

129. *Madrepora obscura*. (Plate XXXII. fig. A.)

Corallum prostrate, consisting of horizontal main divisions with stout, erect, digitiform branchlets on the upper surface, total thickness 9 to 10 cm. Main divisions 1.8 cm. diameter, more or less confluent. Branchlets on the under surface horizontal, 8 mm. diameter and 2 to 4.5 cm. long; on these the corallites are subimmersed at the base, but near the apex a few stout, spreading, tubular corallites occur, some of which bear buds; others between are nariform or appressed tubular. The main divisions give rise on the upper surface to arched branches 12 mm. thick, some of which are simple or subsimple, but the majority are divided into 3 or 4 digitiform branchlets, with the apices about 2 cm. apart; length 3 to 6 cm., diameter over 1 cm., scarcely tapering excepting near the apex, which is very blunt. Axial corallites thick, subcylindrical, 3 mm. diameter, not over 1 mm. exsert, with slightly rounded margin, surrounded by small bursiform radial corallites as in some specimens of *M. seriata*; the star consists of 12 well developed septa. The radial corallites are chiefly of two types, nariform and immersed. The prominent ones are nariform, dimidiate, or gutter-shaped, with thick wall and rounded margin; the inner part of the wall is rarely complete; the immersed corallites extend between the prominent ones to within a short distance

of the apex of each branchlet. The prominent corallites are 2 to 3 mm. long and 2 to 2·5 mm. diameter. About 2·5 cm. below the apex the majority of the corallites are immersed, and the scattered prominent ones have the outer part of the wall convex; 5 cm. below the apex all are immersed. The star of the prominent corallites consists of a moderately developed primary series of septa, the directives being rather broader than the others; in the older ones a second cycle is more or less fully represented, but is not complete. The immersed cells, which are very numerous, rarely exceed 0·7 mm. in diameter; those in the lines of fusion are distinctly smaller; the septa have a similar relative development to that which obtains in the prominent corallites, but the directive septa are distinctly stouter. Corallum porous; surface strongly echinulate and granular; wall striato-echinulate.

Two specimens in the Saville-Kent Collection are more closely related to this species than to any other which has come under my notice, but differ from the type in several points. There are no branchlets on the under surface; the radial corallites are not so unequal, very few are immersed, and the wall is not usually rounded at the margin; also the septa in the prominent corallites are not nearly so prominent, so that no distinct star is recognizable. These specimens in some respects recall the characters of *M. decipiens*.

The position of the species is uncertain.

Indo-Pacific Ocean: Ramesvaram, ? Great-Barrier Reef area.

a. Ramesvaram.	Madras Museum. (Type.)
? b. Rocky Island.	Saville-Kent Coll. 92. 6. 8. 199.
? c. Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 307.

D. *Corallum incrusting, without proper branches.*

130. *Madrepora monticulosa*. (Plate XIV. fig. A.)

Madrepora monticulosa, Brüggemann, Phil. Trans. 1879, vol. clxviii, p. 576.

Corallum incrusting and unifacial; surface covered for the greater part of its extent with large, stout, rounded, subconical prominences, 1·5 to 3 cm. high and 1·7 to 2·7 cm. broad. Axial corallites 3 mm. diameter, thick-walled, only slightly exsert; sometimes several corallites on one cone become thickened and simulate the axial one; septa narrow, primaries subequal, second series more or less rudimentary. Radial corallites much crowded, very short, sublabellate, or nearly tubiform with the inner part of the wall incomplete; equal on the cones, but a little unequal in size, mixed with a few immersed ones, on the plain parts of the corallum; diameter usually 1·5 mm. (Brüggemann gives 2 mm.), length about the same; wall thin, excepting in the upper part of the cones, where it gradually becomes thickened (0·5 to 0·7 mm.), and in many cases the aperture becomes circular; septa very narrow, sometimes only the directives are recognizable. Corallum dense; surface spongy-echinulate; wall finely costulate and echinulate.

A small specimen from the Capricorn Islands agrees closely with the smaller incrusting

specimen from Rodriguez in which the cones are not present; but as in consequence the specific characters are not yet developed, the identity is uncertain.

Indian Ocean : Rodriguez ; ? Great-Barrier Reef.

a, b. Rodriguez. Royal Society [P.]. 76. 5. 5. 93 & 119. (Types.)
c. Capricorn Islands. Saville-Kent Coll. 92. 6. 8. 49.

DIVISION II.

5. Subgenus ISOPORA.

Astræa (part.), Lamarck.

Isopora, Studer, MB. Akad. Wiss. Berlin, 1878, p. 535.

Corallum cormiform, consisting of several thick, blunt, plate-like branches from a common base. The axial corallites are differently arranged to those in all other divisions of the genus *Madrepora*. Usually each axial (parent) corallite forms the axis of a branch or branchlet, and they therefore occur singly. In this subgenus they do not occur singly in typical cases, but a considerable number of closely-arranged parent corallites occupy the centre of each plate, and may be recognized at the margin by their circular wall and central aperture. They are quite normal in form; it is only the fact that they are collected into groups corresponding with the thickness and breadth of the plates that has led to their being overlooked. Radial corallites usually thick-walled, tubular, or cochleariform.

This subgenus corresponds with Dana's Section G of the genus *Madrepora*.

A. *Corallites cochleariform, with thick outer and thin, more or less incomplete, inner wall.*

131. *Madrepora palifera*.

Astræa palifera, Lamarck, Hist. Anim. sans Vert. t. ii. p. 262; ed. 2, p. 409; Lamouroux, Encycl. p. 180.

? *Gemmipora palifera*, Blainville (*non* Dana &c.), Manuel d'Actin. p. 387.

Madrepora labrosa, Dana, Zoophytes, p. 486, pl. xliii. fig. 3, pl. xxxi. fig. 10; M.-Edwards & Haime, Coralliaires, t. iii. p. 161; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16; B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 455.

Isopora labrosa, Studer, MB. Akad. Wiss. Berlin, 1878, p. 535.

Corallum laminate, plates erect or spreading, obtuse, 2 to 8 cm. broad and 1.5 to 4 cm. thick, margin rounded, apex blunt and usually flattened. Corallites at the apex tubular, but usually not prominent, 3 mm. diameter. Walls very porous, 1 mm. thick or more, and frequently confluent. There are two cycles of septa present, both rather narrow, but the directives are thicker than the others. Radial corallites cochleariform or tubular, with incomplete

inner wall; the outer part of the wall always thick, with rounded margin. Diameter usually 2.5 to 3 mm., but variable, some are little over 1 mm.; length 3 to 6 mm. Wall thickly covered with flattened dendritic spines, usually so close as to give a papillose appearance to the upper part of each corallite, but more open below. Septa as in the axial corallites, excepting that the directives are distinctly larger than the other primaries.

A fine specimen from Diego Garcia differs somewhat from the type form. The base gives rise to four stout radiating branches, each of which is 15 to 17 cm. long, and again forked, recalling the habit of *Madrepora alces*, Dana. The apex of each division is rounded, and the tubular corallites are mostly 2 mm. exsert, but in other respects the specimen agrees with more typical examples.

There is a small specimen in the Paris Museum bearing the name *Astraea palifera* in Lamarck's handwriting; the label is gummed on to the specimen, and there seems every reason to suppose, in the absence of other specimens, that this is the type of Lamarck's species. This specimen is identical with *Madrepora labrosa*, Dana, and that name is also written in pencil across the original label. One need have no hesitation as to the identity were it not for the fact that Blainville referred Lamarck's species to the genus *Gemmipora*, and formed a separate section for its reception with the following characters:—"C. Crustiformes et appliques." As the specimen in question consists of only the rounded apex of a plate, the characters given by Blainville may be considered applicable to it, although it is possible that more than one species was included under the name. Later, Dana described and figured *Turbinaria palifera* as the species of Lamarck, and M.-Edwards admitted the entry in his "Coralliaires" without comment; thus *Astraea palifera*, Lamk., and *Turbinaria palifera*, Dana, have hitherto been regarded as identical. It will in future be necessary to regard *Turbinaria palifera* as a new species described by Dana.

Var. *α*.

The specimens numbered *k* to *n* come somewhat intermediate between typical *M. palifera* and *M. brueggemanni*. They have thick branches with broad flat apices, or even sometimes there is only one axial corallite. The radial corallites are irregular, and some are somewhat elongate with a convex outer margin such as occurs in *M. brueggemanni* var. *uncinata*; in other cases the wall is rough, and there is then an approach to the condition of *M. hispida*.

Indo-Pacific Ocean: Torres Straits, Great-Barrier Reef, Sulu Sea, New Guinea, Solomon Islands, China Sea, Diego Garcia.

- a, b.* N.E. Queensland.
- c, d.* New Guinea.
- e, f.* Solomon Islands.
- g.* Tizard Bank, 5 fathoms.
- h.* Diego Garcia.
- i, j.* Capricorn Islands.
- k.* Port Denison.
- l, m.* Palm Island.
- n.* Thursday Island.

- J. B. Jukes, Esq. [C]. 45. 8. 12. 5 & 6.
- Rev. S. Macfarlane [P]. 87. 1. 29. 4 & 5.
- Dr. Guppy [P]. 84. 12. 11. 16 & 17.
- H.M.S. 'Rambler.' 89. 9. 24. 102.
- G. C. Bourne, Esq. [P]. 91. 4. 9. 2.
- Saville-Kent Coll. 92. 6. 8. 50 & 51.
- Saville-Kent Coll. 92. 6. 8. 52. (Var. *α*.)
- Saville-Kent Coll. 92. 6. 8. 53 & 54. (Var. *α*.)
- Saville-Kent Coll. 92. 6. 8. 67. (Var. *α*.)

132. *Madrepora hispida*. (Plate IX. fig. C.)

Madrepora securis, Quelch (*non* Dana), 'Challenger' Reef Corals, p. 148.

Madrepora hispida, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 462.

Corallum similar to that of *M. palifera*, Lamk., consisting of thick plates 4 to 8 cm. broad and 2 to 3.5 cm. thick, or in other cases of thick, elongate, rounded branches, 3 to 6 cm. diameter near the base, and rarely under 3 cm. near the apex. Apices usually flattened. Corallites at the apex 2.5 to 3 mm. diameter, with smaller ones scattered between; walls confluent as in *M. palifera*. Radial corallites usually crowded, but sometimes rather distant, short nariform or tubo-nariform, but the inner part of the wall always short and thin. Diameter 1.5 mm., length 2 mm. The wall and surface of the cœnenchyma consist of radiating spinose plates, giving a very hispid appearance. The septa are arranged in two cycles, the directives broad, the other primaries narrow, the remainder rudimentary. The species differs from *M. palifera*, Lamk., in the smaller size of the corallites and the hispid character of the surface.

Pacific Ocean: Philippines, Banda, Arafura Sea, Ponapé.

a. Banda.	H.M.S. 'Challenger.' 86. 12. 9. 245.	} Types.
	(= <i>M. securis</i> , Quel.)	
b. Philippines.	H.M.S. 'Challenger.' 86. 12. 9. 336.	
	(= <i>M. securis</i> , Quel.)	
c. Samboangan, Philippines.	H.M.S. 'Challenger.' 92. 10. 16. 29.	
	(= <i>M. securis</i> , Quel.)	
d. Flinders Bank, Arafura Sea, 9 fathoms.	H.M.S. 'Penguin.' 92. 4. 5. 2.	
e. Ponapé Island.	Mus. Godeffroy. 81. 11. 21. 8.	

B. *Corallites tubular*.133. *Madrepora securis*.

Madrepora securis, Dana, Zoophytes, pp. 486 & 487, pl. xliii. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 161; Studer, MB. Akad. Wiss. Berlin, 1878, p. 535; Rathbun, Proc. U.S. Nat. Mus. 1878, vol. x. p. 18 (*non* Quelch, 'Challenger' Reef Corals, p. 148).

Corallum cespito-laminate; plates erect, oblong, quadrate at apex and strongly truncate, scarcely lobed, 12 to 25 mm. thick; surface uneven. Corallites very closely crowded, stout and short, tubiform, 1.5 to 2 mm. broad, scarcely striate; aperture entire, circular; star distinct. (*Dana*.)

The type specimen is 15 cm. broad and consists of a cluster of oblong plates from a common base, each 7.5 to 10 cm. long, 5 to 6.3 cm. broad, and 12 to 25 mm. thick. The corallites differ from those of *M. palifera* in size, and also have a circular aperture. In *M. palifera* the margin is wanting on the upperside.

Amirante Islands, East Indies, Solomon Islands.

a-c. Amirante Islands.	H.M.S. 'Alert.' 82. 10. 17. 128, 154, & 211.
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134. *Madrepora cuneata*.

Madrepora cuneata, Dana, Zoophytes, p. 487; M.-Edwards & Haime, Coralliaires, t. iii. p. 161; Quelch, 'Challenger' Reef-Corals, pp. 148 & 149; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15.

Corallum incrusting and spreading, with a few distinct, erect, short, contorted plates 2 to 3 cm. long and 3 to 5 cm. broad. Corallites at the apex as in other species, about 2 mm. diameter; walls confluent. Radial corallites crowded, tubular, with moderately thick wall, generally almost at right angles, varying from subimmersed to 2 mm. in length; diameter 1.5 to 2 mm. On some specimens there are short isolated proliferations at intervals, each with a large central corallite similar in all respects to those at the margin of the plates. Primary septa short, secondaries scarcely noticeable. Wall and cœnenchyma covered with closely packed, blunt, spinose plates.

The specimens from the Capricorn Islands form an interesting series, which illustrate the variety in colony-formation. The youngest specimen consists of an incrusting saucer-shaped plate with an incurved margin, and without erect plates arising from its surface, but the larger (axial) corallites, from which such plates would in time have been formed, are clearly indicated. The 'Challenger' specimen is a portion of a similar colony. The next specimen in the series has an incrusting plate-like base, from which narrow erect plates arise to a height of 6 to 10 cm.; these are 12 cm. broad and 1 to 2 cm. thick. The corallites on the outer surface of the erect plates are not all of the radial type; some of them already indicate new outgrowths, and these form irregular longitudinal corrugations on the surface. Finally, the largest specimen is without the incrusting base; the erect plates are 16 cm. high, and are provided with prominent longitudinal ridges, which in turn have irregular prominences on the surface.

Pacific Ocean: Fiji and Great-Barrier Reef.

<i>a, b.</i> Fiji.	H.M.S. 'Challenger.' 86. 12. 9. 246.
<i>c.</i> Capricorn Islands.	J. B. Jukes, Esq. [P.]. 46. 7. 30. 32.
<i>d-i.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 42 to 47.
<i>?j-l.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 258 to 260.

135. *Madrepora plicata*. (Plate IX. fig. D.)

Madrepora plicata, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 465.

Madrepora incrustans, Rehberg, Abh. naturw. Ver. Hamburg, 1892, Bd. xii. p. 35.

Corallum consisting of broad oblique plates from a common base. The plates are about 8 cm. long and 4 to 9 cm. broad near the apex, narrower below, and 1 cm. thick. Each plate bears one or more prominent longitudinal ridges on its surface. Each ridge bears a number of rosettes of corallites, the central corallite in each being rather larger than the others, thus indicating an approach to branch-formation with its accompanying enlarged terminal (parent) corallite. Corallites at the apices of the plates tubular, 2 mm. in diameter, slightly prominent; wall thick and porous. Radial corallites tubular and appressed above, shorter and

more spreading near the base. Length 1 to 4 mm., diameter 1 to 1.5 mm. Aperture large; wall thin compared with other species of the subgenus. Surface finely clothed with longitudinal series of dentate plates.

The species differs from all others of the subgenus in the possession of thin-walled radial corallites.

A specimen in the Berlin Collection, referred by Rehberg to *M. incrustans*, n. sp., agrees with my type specimen.

Pacific Ocean: Tongatabu, Great-Barrier Reef.

a. Tongatabu.
b, c. Rocky Island.

J. J. Lister, Esq. [P.]. 91. 3. 6. 7. (Type.)
Saville-Kent Coll. 92. 6. 8. 41 & 48.

6. Subgenus TYLOPORA.

Axial corallites broad, usually hemispherical, sometimes slightly exsert at the margin. Corallum cespitose, bushy, or corymbose. Branchlets blunt at the apex. The radial corallites are usually thick-walled, with or without a rounded margin. Septa usually well developed. The *M. nobilis* group shows an affinity to *Eumadrepora*; the *M. humilis* group is related on the one hand to *Isopora*, and on the other, through *M. brueggemanni* var. *uncinata*, to the *variabilis* group of *Conocyathus*.

A. Wall of radial corallites thick, but porous; margin not rounded.

a. Radial corallites spreading tubular, dimidiate or somewhat funnel-shaped, always broader at the apex than at the base.

136. *Madrepora nobilis*.

Madrepora nobilis, Dana, Zoophytes, p. 481, pl. xl. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 143; Verrill (part.), Bull. Mus. Comp. Zool. 1864, vol. i. p. 40; ibid. Proc. Essex Inst. 1866, vol. v. p. 20; ibid. 1869, vol. vi. p. 68; Studer, Mitth. naturf. Ges. Bern, 1880, p. 18; Quelch (part.), 'Challenger' Reef Corals, p. 150; Rathbun (part.), Proc. U.S. Nat. Mus. 1887, vol. x. p. 17.

Corallum shrubby arborescent, in spreading clumps of stout branches. Branches often 2.5 cm. thick, divaricate, terete; summit branchlets 1 to 2 cm. thick; apex conical in some specimens, more pointed in others. Axial corallite 3 to 4 mm. broad and 1 to 3 mm. exsert; wall about 1 mm. thick. On branches with a conical apex the axial corallite is only slightly exsert. Radial corallites much crowded, nearly erect, or somewhat appressed; different specimens and different parts of the same specimen show a considerable variation in the angle at which the corallites are placed. The majority are half-tubular or dimidiate, with the wall a little thickened, not compressed, about 3 mm. long and 1.5 mm. diameter across the lip. Others between are short, labellate, or nariform, with a thin wall, or altogether immersed.

The under surface of the larger branches bears immersed or extremely short corallites only. The axial corallites are provided with 12 septa, all well developed, but a short distance below the margin they commence to taper away, thus forming a funnel-shaped cup. There are also two cycles of septa in the radial corallites; the directives are extremely well developed, and often meet in the middle line, the other primaries are narrow, and the second cycle is still less prominent. Corallum rather porous; surface spongy-reticulate; wall fenestrated when thin, more or less distinctly striate in other cases.

Verrill regards *M. secunda* as a variety of this species, but, so far as one can gather from the original descriptions, they appear quite distinct. The specimens which I have referred to *M. secunda* are certainly distinct. Two specimens in the collection from Singapore, named and received through the Museum of Comparative Zoology, do not appear to me to belong to this species, and have been referred to *M. brueggemanni* var. *uncinata*.

Singapore.

a. Singapore.	Dr. Brüggemann [P.]. 77. 12. 12. 1.
b. —?	Purchased. 56. 2. 18. 29.
c. —?	C. Johnston, Esq. [P.]. 44. 4. 10. 1.
d. —?	Purchased. 47. 1. 19. 4.
e. —?	—? 93. 4. 7. 108.
f. —?	Purchased. 57. 1. 19. 5.
g. —?	—? 30. 12. 15. 1.
h. Java.	Purchased. 59. 12. 12. 7.

137. *Madrepora canalis*.

Madrepora canalis, Quelch, 'Challenger' Reef Corals, p. 150, pl. ix. fig. 2.

Corallum arborescent, consisting of stout branches 2 to 2.5 cm. thick, giving rise at intervals to clusters of 3 or 4 branchlets at the same level; the older ones 6 or 7 cm. long and nearly 2 cm. thick near the base, gradually tapering; apical branchlets about 1.5 cm. long and 7 mm. thick. Axial corallites 3.5 mm. diameter, not exsert; wall thick and very porous; septa in two cycles, both well developed. Radial corallites spreading almost at right angles, crowded, chiefly dimidiate, with a very thick wall, thicker (1 mm.) at the margin than below, 2 to 3 mm. long and 3 mm. diameter across the spout-shaped and thickened apex. A few smaller, chiefly labellate, corallites are scattered between the others, but scarcely destroy the general symmetry. In the radial corallites the septa are in two cycles, but the directives are here distinctly broader than the others. Corallum porous; surface reticulate and strongly echinulate; wall very porous, striato-reticulate and echinulate.

This species resembles *M. nobilis* closely in mode of branching and in the thickened porous wall of the radial corallites. The axial corallites are, however, not exsert, and the radial ones are decidedly broader at the apex than below, erect, and subequal.

Philippine Islands.

a. Samboangan.	H.M.S. 'Challenger.' 86. 12. 9. 268. (Type.)
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138. *Madrepora dactylophora*.

Madrepora digitifera, Studer (*non* Dana), MB. Akad. Wiss. Berlin, 1878, p. 530.

Corallum stout, corymbose, without fusions, sometimes 40 cm. broad. Central branches simple, but those at the margin are more or less subdivided; length 5 to 6 cm., diameter 1.5 cm. Axial corallites 4 mm. diameter, 1 mm. exsert; wall very thick. Radial corallites short, broad, tubular, spreading at right angles; aperture oblique, margin very sharply defined; the majority are subequal, 2 to 3 mm. long, thick-walled, broader at the apex than at the base; lip frequently 3 mm. diameter, oblique, sharply defined, with small aperture; a few, which are more elongate, are proliferous. Immersed or short labellate corallites are scattered between the others, and all are more unequal in length near the base of the branches. A few prominent corallites have the inner part of the wall wanting. Corallum rather dense; surface spongy-echinulate; wall striato-echinulate.

Pacific Ocean: Salawatti, New Guinea (*Berlin Museum*).

139. *Madrepora eurystoma*.

Madrepora eurystoma, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 16, pl. i. fig. 8, pl. iv. fig. 7, pl. ix. fig. 12; Ortmann, Zool. JB. 1888, Bd. iii. p. 152.

Corallum corymbose, often 30 cm. broad, very porous and fragile. Branches 1.5 to 2 cm. thick at the base, much divided, with numerous short proliferations near the apex. Axial corallites 3 to 4 mm. diameter, about 2 mm. exsert; wall moderately thick, margin a little rounded, aperture 1 mm. diameter. Radial corallites 3 to 4 mm. broad, mostly short (2 to 3 mm.), but on some of the twigs they are 5 mm. long, half-funnel-shaped to tubular, with an oblique aperture, and usually broader at the margin than at the base; wall more or less thickened, but very porous; aperture wide, often 2 mm. A few small thin-walled corallites are scattered between the prominent ones, and towards the base of the branches all become very short, with a thin cylindrical wall and wide aperture; very few are completely immersed. The star consists of one or two cycles of septa, which taper-away towards the lip of the corallites, so as to appear situated deep down. Corallum very porous and reticulate in section; surface spongy-reticulate and echinulate, but denser in parts; wall striato-reticulate, becoming striate and echinulate on the stouter corallites.

Var. *parvula*.

A variety from Diego Garcia consists of an elongate, prostrate, and flattened branch, 3 by 2 cm. diameter and 20 cm. long, bearing chiefly immersed corallites on the under surface. On the upper surface the ultimate divisions are erect, 1 to 3 cm. long, and about 8 mm. diameter. Axial corallites usually about 3 mm. diameter, with a wide aperture and relatively thin wall. Radial corallites short, rarely over 2 mm. diameter, and scarcely so spreading as in the type.

Indian Ocean: Red Sea, Diego Garcia, Maldive Islands, Torres Straits.

<i>a.</i> Koseir, Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 5.
<i>b.</i> Maldive Islands.	Colonial Exhibition. 86. 11. 22. 8.
<i>c, d.</i> Diego Garcia.	G. C. Bourne, Esq. [P.]. 91. 4. 9. 1 & 8.
<i>e.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 297.
Var. <i>parvula</i> .	
<i>a.</i> Diego Garcia.	G. C. Bourne, Esq. [P.]. 91. 4. 9. 11.
? <i>b, c.</i> — ?	— ? 93. 4. 7. 119 & 136.

b. Radial corallites not wider at the apex.

* *No proliferous corallites excepting such as indicate new branches.*

140. *Madrepora fruticosa*. (Plate XVIII. fig. A.)

Madrepora fruticosa, Brook, Ann. Mag. N. H. 1892, vol. x. p. 457.

Corallum bushy caespitose, upper surface hemispherical; 18.5 cm. high and 25 cm. wide, from a round incrusting base about 12.5 cm. in diameter. Marginal branches very short and reflexed, others rapidly increasing in length towards the centre; middle branches 9.5 cm. long and 2 cm. thick near the base, angular below; the majority are bi- or trifid, each division being usually again divided; the majority of the divisions are 1.5 cm. diameter and have a blunt apex; apices about 3 cm. apart. Axial corallites 4 to 5 mm. diameter, sub-hemispherical; wall very porous. Radial corallites prominent, spreading, and relatively regular, a little compressed, chiefly tubiform with the inner part of the wall more or less incomplete; the inner part always thin, the outer usually very thick but porous, margin plane; length 3.5 to 5 mm., diameter 2.2 to 2.5 mm.; the outer part of the wall is convex in those corallites situated some distance below the apex, and the inner part of the wall is almost absent; nearer the base the corallites are quoit-shaped, becoming completely immersed on the main divisions. A few small thin-walled or subimmersed corallites are scattered between the more prominent ones, but are not sufficiently numerous to destroy the general appearance of regularity. Short proliferous corallites are of frequent occurrence, and may be first recognized by the fact that the inner part of the wall becomes as prominent and as thick as the outer. Corallum porous; surface spongy-echinulate; wall striato-reticulate at first, becoming echinulate in linear series below.

The star of the radial corallites consists of a primary series of septa, of which the directives are well developed, and, excepting near the apex of a branch, of a more or less complete second cycle.

This species differs in a marked degree from *M. spectabilis* in habit and in the general appearance of the middle branches, but the radial corallites have here almost precisely the same form and arrangement throughout the colony as occurs on the marginal divisions of *M. spectabilis*. On this account the two forms may ultimately prove to be varieties of one species. In habit the species approaches *M. erythraea*, Klz.

Torres Straits and Great-Barrier Reef. (The habitat of the type specimen is not recorded.)

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|---------------------------|-----------------------------------|
| <i>a.</i> —? | —? 93. 4. 7. 89. (Type.) |
| <i>b.</i> Port Denison. | Saville-Kent Coll. 92. 6. 8. 120. |
| <i>c.</i> Warrior Island. | Saville-Kent Coll. 92. 6. 8. 127. |

141. *Madrepora tubicinaria*.

Madrepora tubicinaria, Dana, Zoophytes, p. 451, pl. xxxii. fig. 7; M.-Edwards & Haime, Coralliaires, t. iii. p. 152; ? Verrill, Proc. Essex Inst. 1866, vol. v. p. 23; ? ibid. 1869, vol. vi. p. 100; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

Corallum forming small round subcespitose clumps about 12 cm. high, consisting of several branching stems rising from a common base. Branches little spreading, closely divided, nearly terete, 6 to 8 mm. thick, scarcely at all tapering; apex obtuse. Axial corallites 2 to 3 mm. thick, a little prominent. Radial corallites regular, appressed tubiform or cylindrical, applied at one side nearly or quite to the apex; length 3 to 4 mm., diameter 1.6 mm., thin and fragile at the margin, exterior neatly striate; aperture broad and circular, opening upwards; star narrow, six-rayed. (*Dana*.)

Unless the specimen from Tahiti recorded by Verrill should prove to belong to this species, which seems very doubtful, the form has not hitherto been identified by subsequent investigators.

There is a specimen in the collection of the British Museum, the habitat of which is not recorded, which may belong to this species. It has the following characters:—Corallum subcespitose, hemispherical, 22 cm. diameter and 14 cm. high. The colony consists of numerous forked and closely divided branches arising from an incrusting base, always more or less proliferous near the apex. Branches 1.5 cm. diameter at the base; distal divisions about 8 mm. diameter. Axial corallites 3 to 4 mm. diameter, hemispherical; wall thick and porous. The star consists of twelve septa of moderate development, the directives sometimes more prominent than the other primaries. Radial corallites subequal, tubiform, with a round aperture, nariform at first, appressed or a little spreading, length 2 to 3 mm., diameter 1 to 1.5 mm.; inner part of the wall often thin, outer part a little thickened but quite porous, margin not rounded. On the middle divisions the corallites are very short, with a ring-shaped border; on the main branches all are immersed. In the tubular corallites only the directive septa are present, both are of moderate breadth, apparently the inner is often broader than the outer; below, in the subimmersed and immersed corallites, the star is quite distinct and consists of a well-developed primary series and a more or less complete second cycle.

Pacific Ocean: Fiji, ? Tahiti.

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|--------------|-------------------|
| <i>a.</i> —? | —? 93. 4. 7. 115. |
|--------------|-------------------|

142. *Madrepora bottæ*.

? *Madrepora pharaonis*, M.-Edwards & Haime, Coralliaires, t. iii. p. 143 (part.).

Corallum cespitose from a central base, with very few immersed corallites below; height

17 cm., breadth 21 cm. Peripheral branches short, 2·5 cm. long, subsimple, the others increasing in length and diameter towards the centre; central branches 2 cm. thick, divided into five main divisions at the same level, each of which is a little over 1 cm. diameter and again subdivided; ultimate branchlets slender digitiform, with a very blunt apex; about 3 cm. long and 7 mm. diameter, very slightly tapering. Axial corallites 3 to 4 mm. diameter, hemispherical, aperture very small. Radial corallites distant, thick, nariform or tubonariform, 3 mm. long and 2·5 mm. wide, but narrower and pointed near the apex; some are completely tubular and indicate new proliferations. The axial corallites are provided with six moderately developed septa, the directives a little broader than the others; in the radial corallites the directive septa are very broad and the other four quite narrow. Corallum moderately porous in section; surface and wall strongly and closely echinulate throughout.

The type specimen in the Paris Museum forms part of M. Botta's collection from the Red Sea. The label bears the name *M. pharaonis*, M.-Edwards & Haime, but the specimen is so unlike the types of that species that it seems improbable Milne-Edwards would have included it under that name. The species resembles *M. fruticosa* and certain specimens of *M. seriata* somewhat in habit, but has distant corallites of different shape.

Red Sea. (*Paris Museum.*)

143. *Madrepora amblyclados*.

Madrepora cf. *globiceps*, Ortmann, Zool. JB. 1888, Bd. iii. p. 151 (part.).

Madrepora plantaginea, Ortmann (*non* Lamarck), Zool. JB. 1888, Bd. iii. p. 151 (part.).

Corallum cespitose from a broad base, 10 to 15 cm. high and about 18 cm. broad. Main branches 2 cm. thick, bearing digitiform branches 2 to 2·5 cm. long and 1 to 1·3 cm. thick, more divided in some specimens than in others. Axial corallites 3·5 to 4·5 mm. diameter, occasionally 5 mm., scarcely exsert; wall very thick, aperture round or oval, 1 to 1·2 mm. when round. Radial corallites ascending, tubular, with a moderately thick wall and very oblique aperture, but the inner part of the wall is rarely absent excepting in young corallites; length of the outer part of the wall 3 mm. or a little over; diameter a little variable, usually about 2 mm. Directive septa broad, the others rudimentary. Corallum moderately porous; surface spongy-echinulate; wall faintly striate, echinulate near the base.

Four out of the five specimens doubtfully referred to *M. globiceps* by Ortmann appear to me to belong to this species. The fifth (Indian Ocean, *Conrad*) is referred to *M. platycyathus*. The Singapore specimen referred by Ortmann to *M. plantaginea* should probably be referred to this species also, but the branchlets are more proliferous at the apex and the radial corallites have scarcely so thick a wall as in the other specimens.

Indo-Pacific Ocean: Indian Ocean (2 sp.); Singapore (2 sp.); Australia (1 sp.) (*Strasburg Museum*).

144. *Madrepora diversa*. (Plate XVI. fig. B.)

Madrepora diversa, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 461.

Corallum cespitose from a broad incrusting base, 10 cm. high and 18 cm. broad. Branches 4.5 cm. long, 1.3 to 1.8 cm. thick, simple or divided into 2 to 5 little-spreading digitiform branchlets about 2.5 cm. long and 1 cm. thick, obtuse at the apex. Axial corallites 3.5 to 4 mm. broad, scarcely exsert. Radial corallites chiefly tubular, with a more or less oblique aperture, very unequal in length and diameter; all are ascending. The larger ones are 3 to 6 mm. long and 2 to 2.5 mm. diameter, slightly compressed; wall thick, but only slightly rounded at the margin; smaller nariform or subimmersed corallites occur between the others quite to the apex; a few are proliferous and 5 to 8 mm. long. About 2 cm. from the apex the prominent corallites are nariform or tubo-nariform, with a thick and strongly curved outer wall; at the base nearly all are immersed. Star indistinct, often only the directive septa are recognizable. Corallum moderately porous; surface strongly echinulate; wall finely striato-echinulate.

Indo-Pacific Ocean: Diego Garcia, Torres Straits.

a. Diego Garcia.

G. C. Bourne, Esq. [P.]. 91. 4. 9. 4. (Type.)

b. Thursday Island.

Saville-Kent Coll. 92. 6. 8. 309.

** *Branches provided with numerous short proliferous corallites or twigs.*

145. *Madrepora spectabilis*. (Plate XVIII. fig. B.)

Madrepora spectabilis, Brook, Ann. Mag. Nat. Hist. 1892, vol. x. p. 462.

Corallum corymbose, 28.5 cm. diameter, base 14.5 cm., outer branches oblique and proliferous, fusions rare, the upper surface only slightly convex. On the under surface of the outer branches the subdivisions are horizontal, frequently acervate, 1 to 2.7 cm. long, and bear numerous irregular and spreading tubular corallites, 5 mm. or more in length and about 2.4 mm. diameter, others are nariform or subimmersed. Main branches 6 cm. long and erect near the centre of the corallum, but near the margin the length is 8 or 9 cm. and the branches are arched, with the subdivisions chiefly on the outer side; the diameter at the base is usually 2 cm. and 1.5 cm. at a point about 1 cm. below the apex; the central branches are simple, blunt, digitiform, or may be divided near the base into two or three branchlets, the basal parts are usually angular in section owing probably to crowding; the apices are about 2.5 cm. apart; the greatest diameter (including corallites) is often 2.5 cm. in the middle of a branch. Axial corallites very stout, hemispherical, 6 to 7 or even 8 mm. diameter, aperture 1.5 mm. The radial corallites vary considerably in form and regularity in different parts of the corallum; on the marginal branchlets nearly all are tubular or subtubular, with the inner part of the wall more or less incomplete, and extend at an angle of about 45°; length 2 to 2.5 mm., diameter 1.5 to 1.75 mm.; wall a little thickened excepting in the inner part,

margin not rounded; on the central branches the corallites are more unequal, many are tubular, dimidiate, or spout-shaped, with smaller thin-walled corallites between, but a little distance below the apex the majority are dilated, nariform, bursiform, or subimmersed, many of the dilated corallites are 2.5 mm. broad with a rounded margin; numerous stouter, tubular corallites, 2.5 mm. long and broad, occur at irregular intervals and indicate new outgrowths, they are often collected into irregular groups at a point about 1 cm. below the apex of a branch; the bases of the branches are occupied by verruciform and immersed corallites. The star consists of six moderately developed primary septa, of which the directives are a little prominent; sometimes a very narrow second cycle is also present. Corallum porous; surface covered with short blunt echinulations; wall thick and very porous, striato-reticulate above, becoming echinulate below.

The habitat of the type specimen is not recorded.

a. —?

—? 93. 4. 7. 88. (Type.)

146. *Madrepora gemmifera*. (Plate XXI.)

Madrepora gemmifera, Brook, Ann. Mag. N. H. 1892, vol. x. p. 457.

? *Madrepora seriata*, Quelch (non Ehrenberg), 'Challenger' Reef Corals, p. 155.

Corallum massive corymbose, 35 cm. wide and 12 cm. high, base incrusting, 14 cm. diameter. Branches simple, erect, and digitiform near the centre, 4 to 6 cm. long and 1.5 to 2.5 cm. diameter, often quadrate and proliferous near the base, conical above. Marginal branches 8 to 10 cm. long, often divided into two principal arcuate and ascending divisions similar to those nearer the centre, but the outer one bears on its outer surface numerous spreading twigs 8 to 16 mm. long and 5 to 10 mm. thick. Axial corallites hemispherical, 4 mm. diameter; septa in two cycles, both of which are narrow, directives a little more prominent than the other primaries. Radial corallites broad, spreading, subtubular or gutter-shaped, with small immersed cells between. The prominent corallites increase in length from the apex downwards, and are often arranged in irregular rows, with immersed ones between; those near the apex are 2 mm. diameter or a little over, about 1.5 mm. long; wall thickened, but wanting or thin and incomplete on the inner aspect, margin not rounded. Those situated some distance below the apex may be 3.5 mm. diameter, the upper part of the wall scarcely thinner than the lower; such corallites are 4 mm. long, and bear a few buds near the base; others still lower may form proliferations 8 to 16 mm. long, and in such cases the axial corallite gradually acquires a rounded margin. Star of the radial corallites indistinct, often only the directive septa are recognizable. Some of the prominent corallites situated near the base of the central branches do not form buds and assume a verruciform outline. Corallum dense, surface closely reticulate and echinulate, wall closely striato-echinulate. The habit and stoutness of the branches recall *M. spectabilis*, but the axial corallites are much smaller than in that species. The radial corallites are stouter and more proliferous, the star is much less distinct, and immersed corallites are much more numerous and extend to near the apex of each branch. The numerous proliferous twigs

near the base of the branches give the species a general resemblance to *M. scherzeriana*, but the corallites are of quite a different type. In immature specimens the prominent radial corallites have not quite such a thick wall, and the proliferations near the base of the branches are neither so numerous nor so well marked.

Pacific Ocean : Fiji, Great-Barrier Reef, Torres Straits, Arafura Sea.

<i>a-c.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 114 to 116. (Types.)
<i>d.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 117.
<i>e.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 118.
<i>f.</i> Kandavu, Fiji.	H.M.S. 'Challenger.' 86. 12. 9. 289. (= <i>M. seriata</i> , Quelch.)
<i>g.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 119.
<i>h-j.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 123, 125 & 126.
<i>k.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 298.
? <i>l.</i> Evans Bank, Arafura Sea.	H.M.S. 'Penguin.' 92. 4. 5. 5.

147. *Madrepora samoensis*. (Plate VI. fig. C and Plate XXXI. fig. A.)

Madrepora samoensis, Brook, Ann. Mag. N. H. vol. 1891, viii. p. 468.

Corallum cespitose from a broad, rounded, incrusting base; height of corallum 24 cm., breadth 28 cm. Branches very stout and much divided. The main branches usually become divided into 8 or 10 secondary ascending branches, which increase in length towards the centre of the corallum; the outer ones are 3 to 5 cm. long, the inner ones 12 or 13 cm.; these branches are often 2 cm. thick, not terete, but owing to crowding they are more or less angular in section; the secondary branches bear a third series of ascending branchlets, 2 to 6 cm. long and 1 cm. thick, those directed outwards being longest and most numerous. All the divisions are only slightly tapering and have a blunt apex. Axial corallites 3 mm. diameter, or less in the case of the smaller subdivisions, scarcely exsert; wall thick, very porous, margin rounded. Star very distinct, the primary septa often nearly meet in the middle line, but in the smaller corallites the directives are largest; a second cycle is also moderately developed. Around the axial corallites the radial corallites are frequently arranged in subregular longitudinal rows. The radial corallites are nariform or short tubular at first, with the inner part of the wall more or less incomplete, the outer part thickened and very porous; they are 2 to 3 mm. long and about 2 mm. diameter. Rows of smaller, subimmersed corallites are situated between the prominent ones, but the linear arrangement is lost 3 to 5 cm. from the apex. At a point about 2 cm. from the apex the prominent corallites become more thickened and bear buds; they are then about 4 mm. long and nearly 3 mm. diameter. Such proliferous corallites occur at intervals of 5 to 8 mm. over the whole of the upper part of the corallum; a few become more elongate and may attain a length of 2 cm. At a point varying from 2.5 to 6 cm. from the apex of a branch or branchlet the whole of the corallites become short, and on the inner side of the branches almost all of them are immersed. The star of the radial corallites not destined to form

proliferations is quite indistinct, usually only the directive septa are recognizable. Corallum very porous; surface spongy-reticulate, becoming regularly reticulate below; wall striate and fenestrated, margin not rounded.

Pacific Ocean.

a-c. Samoa Islands.

Rev. S. J. Whitmee [P.]. 75. 10. 2. 18 to 20. (Types.)

148. *Madrepora scherzeriana*.

Heteropora hemprichii, Haeckel (*non* Ehrenberg), Arab. Korallen, pl. iii. fig. 6.

Madrepora scherzeriana, Brüggemann, Abhandl. naturw. Ver. Bremen, 1877, Bd. v. p. 397, pl. viii.; Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 9.

Corallum cespitose; branches thick and stunted, little divided, 15 mm. thick, with here and there a short ascending proliferous twig. Axial corallites little larger than many of the radial ones, 3.5 mm. diameter, wall thick and porous, margin rounded, aperture 0.5 mm., star well developed. Radial corallites irregular, but placed in rows near the apex of a branch. On the distal part of a branch the majority are short, stout, tubular, with a rounded margin and striate wall, a little unequal in size, but many nearly as stout as the axial corallites, with immersed ones between. The lower part of the branches bear thick verruciform corallites and immersed ones at the base. Cœnenchyma very spongy and echinulate.

The branches bear numerous bud-corallites up to 8 mm. long and 5 mm. thick; these gradually increase in importance towards the base of the colony, where they form twigs 3 cm. long. The species differs from *M. seriata* in the more pointed and more proliferous branches, and the inner part of the corallite-wall is rarely incomplete.

A specimen in the Collection from Ceylon which appears referable to this species has the branches 6 to 8 cm. long and 1 to 1.5 cm. thick, little divided, and scarcely tapering excepting near the apex. Axial corallites 3 to 4 mm. thick, hemispherical, or with rounded margin. The prominent radial corallites are chiefly stout, tubular, or dimidiate, many are 3.5 mm. diameter and 5 mm. long, and the majority are 2.7 to 3 mm. diameter, with a thick wall and rounded margin, with a few small subimmersed ones between. The aperture is by no means always central; usually the inner part of the wall is shorter and comparatively thin until the corallite has attained its full development. Proliferous corallites are numerous, and may attain a length of 1 cm. The septa are arranged in two well-developed cycles; in many of the radial corallites the outer directive is much broader than the others. Corallum very porous; surface spongy-echinulate; wall substriate and echinulate.

Var. *spongiosa*.

A form which may be a variety of this species is remarkable for its extreme porosity. It is subarborescent in habit. The branches are 10 cm. long and 1.5 to 2 cm. thick, gradually tapering to an axial corallite 4 mm. in diameter. The corallites on the apical part of a branch are similar to those in the Ceylon specimen, but 3 cm. below the apex the

majority are subimmersed or immersed with an aperture of 2 mm.; between these a number of stout, prominent, proliferous corallites occur, 4 to 15 mm. long; a few form branchlets 7 cm. in length, and are again proliferous. The wall is extremely porous and reticulate, scarcely striate.

Indian Ocean: Red Sea, Maldive Islands, Ceylon.

a. Galle, Ceylon.

Dr. Ondaatje [P.]. 83. 4. 26. 2.

b. Maldive Islands.

Colonial Exhibition. 86. 11. 22. 1. (Var. *spongiosa*.)

B. Branches stout and usually acervate, sometimes with more than one axial corallite.

Radial corallites appressed; wall thick and margin rounded.

149. *Madrepora humilis*.

Madrepora humilis, Dana, Zoophytes, p. 483, pl. xli. fig. 4, pl. xxxi. fig. 4; M.-Edwards & Haime, Coralliaires, t. iii. p. 147; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16.

Corallum low, fruticose, spreading and short, stout, ramose, subproliferous; branches terete, obtuse, 12 to 16 mm. thick. Axial corallites 4 to 4.5 mm. diameter, scarcely exsert. Radial corallites equal and even, somewhat crowded (Dana's figure shows them rather distant), very stout, neat nariform, 2 mm. diameter, becoming less prominent below; aperture oblong. Star scarcely distinct, the directive septa prominent and nearly meeting below. (*Dana*.)

Rathbun records another specimen 24 cm. broad and 11 cm. high. The base is much thickened, the longest branch being only 6.5 cm. and the stoutest 1.8 cm. thick.

The fragments in the Saville-Kent Collection consist of very blunt asparagus-like branches, very closely covered with echinulate plates, which give a glaucous appearance on the surface. The radial corallites are narrow, appressed, subnariform, and usually quite isolated, as shown in Dana's figure, but in one specimen they are rather crowded. The branches are 2 cm. thick and 9 to 14 cm. long, little divided, except near the apex. Axial corallites 5 to 6 mm. diameter, hemispherical. Radial corallites on the distal parts stouter than those below, hemicotyloid, nariform or cochleariform, with thick wall and rounded margin, appressed above; but many are wart-like and suberect towards the base; length 2 to 3 mm., diameter 1.5 to 3 mm., average about 2 mm. The star usually consists of 6 septa, the directives stouter and broader than the others; sometimes they bear lateral processes.

Fiji Islands; Great-Barrier Reef.

a, b. Palm Island.

Saville-Kent Coll. 92. 6. 8. 58 & 59.

c. Adolphus Island.

Saville-Kent Coll. 92. 6. 8. 239.

150. *Madrepora brueggemanni*. (Plate XXIV. and Plate XXXV. fig. E.)

Madrepora lava, Brüggemann (*non* Lamarek), Abh. naturw. Ver. Bremen, 1877, Bd. v. p. 544; Studer, Mitth. naturf. Ges. Bern, 1880, p. 18; Ortmann, Zool. JB. 1888, Bd. iii. p. 149.

Madrepora acervata, Studer (*non* Dana), Mitth. naturf. Ges. Bern, 1880, p. 22.

? *Madrepora pelewensis*, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 41, pl. iii. fig. 11.

Corallum spreading arborescent, laxly branched. Main branches stout, 2 to 3 cm. thick; branches long, lax, and turned in various directions, or short, stunted, divaricate, and obtuse at the apex. Elongate branches 15 cm. long and 1.5 cm. thick, little divided, scarcely tapering, except near the apex; stunted form of similar diameter, but more frequently and divaricately divided; ultimate divisions 2 to 3 cm. long, 1 to 1.5 cm. thick, scarcely tapering, very obtuse at the apex. A few short conical buds, or abortive branchlets, are scattered at intervals from the base upwards. Corallum rather dense; surface finely and thickly granular, the "granulations" consist, as in other cases, of clubbed spinules with rough apices, or of scabrous narrow plates in rows. Axial corallites very variable in size, sometimes 4 to 6 mm. in diameter, with very thick wall, not exsert, or only slightly so; in other cases conical, 2 mm. exsert, 4 to 5 mm. diameter at the base, and about 3 mm. at the apex. In certain cases, where the terminal divisions are very stout, a single axial corallite does not occur, but instead the apex is occupied by several stout, cylindrical corallites, with only the rounded margin prominent. This clearly is an approach to the condition in the subgenus *Isopora*. Radial corallites crowded, very unequal and irregular on the upper surface, but more distant below; they are usually short, thick, spreading tubular, with small aperture and rounded margin; 2 to 2.5 mm. diameter and 2 to 5 mm. long, but most are short. At intervals certain corallites become more elongate and thickened, and develop buds. The inner part of the wall is often not so thick and prominent as the outer, in which case the aperture opens inwards; the outer part of the wall may project in a point or hooked knob some distance above it. This type of corallite is most frequent in certain elongate branched specimens, which probably constitute a distinct variety. Star well developed, primary septa broad and subequal, the others not so prominent; wall finely and closely granular, echinulate, the echinulate plates often arranged in rows at the base of the corallites. Immersed corallites are not numerous, and occur only on the under surface of the branches.

Var. *uncinata*. (Plate XXXV. fig. E.)

? *Madrepora nobilis*, Verrill (*non* Dana), Bull. Mus. Comp. Zool. 1867, vol. i. p. 40 (part.).

? *Madrepora scabrosa*, Bassett-Smith (*non* Quelch), Ann. Mag. N. H. 1890, vol. vi. p. 452.

Branches relatively elongate and tapering towards the apex; radial corallites with a rounded margin, tubular with an oblique aperture, becoming uncinata or shovel-shaped; very unequal in size, often a little compressed. Axial corallites 3 to 4 mm. diameter or a little over, usually 1 to 2 mm. exsert.

Indo-Pacific Ocean: Singapore, ? Tizard Bank, Torres Straits, Great-Barrier Reef.

<i>a, b.</i> Singapore.	Purchased. 78. 4. 1. 1 & 2. (Types.)
<i>c-f.</i> N.E. Australia.	H.M.S. 'Alert.' 93. 4. 7. 101 to 104.
<i>g.</i> Warrior Island.	Saville-Kent Coll. 92. 6. 8. 55.
<i>h, i.</i> Palm Island.	Saville-Kent Coll. 92. 6. 8. 56 & 57.
<i>j.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 121.

<i>k.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 122.
<i>l.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 277.
Var. <i>uncinata</i> .	
<i>a, b.</i> Singapore.	Mus. Comp. Zool. Harvard Coll. 91. 6. 16. 1 & 2.
<i>c.</i> Wreck Bay, Great-Barrier Reef.	J. B. Jukes, Esq. [P.]. 46. 7. 30. 26.
? <i>d.</i> Tizard Bank.	H.M.S. 'Rambler.' 89. 9. 24. 100. (= <i>M. scabrosa</i> , B.-Sm.)

151. *Madrepora ortmanni*.

Madrepora crassa, Ortmann (*non* Edwards & Haime), Zool. JB. 1888, Bd. iii. p. 149.

Corallum subarborescent, the divisions very stout. Branches 10 cm. long and 3 cm. thick, bearing 4 or 5 thick digitiform branchlets nearly 2 cm. thick; in certain cases, owing apparently to the fusion of two branches, they form oval spreading lobes 8 cm. long, 3.5 cm. broad, and 2 cm. thick, the apex oval, 2 cm. by 1 cm., with 2 axial corallites separated by others of the radial type. Here, as in *M. brueggemanni*, there is, in certain branches, an approach to the condition of the subgenus *Isopora*. Axial corallites 4 mm. diameter, little exsert; wall rounded, with a large aperture (2 mm.) and deep-seated star of 12 septa. Radial corallites long, appressed, tubular, crowded, and markedly imbricate, but in some parts more spreading and irregular; diameter 2.5 to 3 mm., length up to 6 mm., or even more; wall moderately thick, aperture large, margin rounded. The star consists of 6 well-developed septa, and of a more or less complete second cycle. Corallum dense, but still reticulate in section; surface reticulate, with a spongy film in places; wall finely echinulate, not striate, echinulations longer near the base of the corallites.

Pacific Ocean: Ponapé and Bowen, Queensland (*Strassburg Museum*).

152. *Madrepora acervata*.

Madrepora acervata, Dana (*non* Verrill), Zoophytes, p. 460, pl. xxxiv. fig. 4; M.-Edwards & Haime, Coralliaires, t. iii. p. 154; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 12 (*non* Studer, Mitth. naturf. Ges. Bern, 1880, p. 22; *non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 454).
Madrepora plantaginea, Verrill (*non* Lamarek, *non* Dana), Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; *ibid.* Appendix, 1875 ed. of Dana's Corals & Coral Islands, p. 333.

Corallum broad, cespitose, a little convex above; exterior branches nearly prostrate and somewhat flattened below. Branchlets 5 cm. long and 1 to 1.6 cm. thick, very proliferous, often acute at the apex and subretuse. Axial corallites broad, 3 to 4 mm., scarcely exsert; aperture scarcely one-fourth the diameter. Radial corallites crowded, appressed, tubiform, 2 to 3 mm. long; wall distinctly striated, oblique at the apex; lip thick; aperture elliptical; star very distinct, the directive septa nearly meet below. (*Dana*.)

Singapore.

*C. Radial corallites with thick dense wall and rounded margin.**a. Inner part of the wall complete; aperture central.*153. *Madrepora klunzingeri*.

Madrepora pustulosa, Klunzinger (*non* M.-Edwards & Haime), Korallenth d. roth. Meeres, Th. ii. p. 8, pl. i. fig. 1, pl. iv. fig. 15, pl. ix. fig. 4.

Madrepora klunzingeri, Quelch, 'Challenger' Reef Corals, p. 158.

? *Madrepora papillosa*, n. n., Klunzinger, op. cit. p. 9.

Corallum small and cespitose, 8 to 10 cm. high and broad; branchlets chiefly digitiform, 3 to 6 cm. long and 1 to 1.5 cm. thick, but tapered a little near the apex. Axial corallites hemispherical or short conical, 5 to 6 mm. broad; aperture scarcely 1 mm. Radial corallites short, cylindrical, with rounded margin 2 to 4 mm. long and broad, with round aperture 1 mm. in diameter. Corallum rather porous in section; surface spongy-echinulate.

Red Sea.

154. *Madrepora ocellata*.

Madrepora ocellata, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 9, pl. i. fig. 7, pl. iv. fig. 14, pl. ix. fig. 5; Ortmann, Zool. JB. 1889, Bd. iv. p. 505.

Corallum low, cespitose, 8 to 10 cm. wide and 2 to 4 cm. high. Branches digitiform, obtuse, little divided excepting near the apex, 2 to 4 cm. long, 1 cm. thick. Axial corallites 4 to 5 mm. broad and 1 to 2 mm. exsert, thick-walled with rounded margin and small (1 mm.) aperture. Radial corallites not crowded, usually nariform or tubular, 3 to 4 mm. long and 2 mm. broad, slightly compressed; aperture small, round elliptical or oblique, outer part of wall a little thickened and margin rounded; some of the tubular ones are elongate (7 mm.). Near the base of the branches the corallites are verruciform with a few immersed ones interspersed. Corallum porous above; surface echinulate or spongy-reticulate; wall not striate.

A specimen from Ceylon described by Ortmann differs from the type in having smaller axial corallites, 3 to 4 mm. diameter and 1 mm. exsert. The species approaches *M. klunzingeri* closely, and differs chiefly in the form of the radial corallites and in the thickness of the wall.

Indian Ocean: Red Sea, Ceylon.

a. Ceylon.

Haeckel Coll. 92. 12. 5. 7.

155. *Madrepora cophodactyla*. (Plate XXIII. fig. E.)

Madrepora cophodactyla, Brook, Ann. Mag. N. H. 1892, vol. x. p. 455.

Corallum broad, flattened, cespitose; base 20 cm. diameter. Branches stout, short, suberect and very obtuse at the apex, simple, or divided near the middle into two or more ascending

branchlets; length 3 to 5 cm., diameter 1·7 to 2 cm. at the base, and usually over 1 cm. just below the apex. Axial corallites 3 to 3·75 mm. diameter, scarcely exsert; aperture usually small, 1 mm. Radial corallites practically all of the same type, stout and dilated, appressed tubular, with the inner part of the wall a little shorter than the outer, margin much rounded, aperture more or less elliptical; diameter 2·2 to 3 mm., length 2 to 3 mm.; a few are proliferous and those nearer the base are more appressed; immersed corallites confined to the base of the branches and the intervals between them. The star consists usually of 12 septa, but none of them are very prominent. Corallum very dense; surface and wall finely and closely echinulate.

This species resembles *M. globiceps* in the thickness and blunt apices of the branches; but has much stouter corallites, axial as well as radial.

Habitat not recorded.

a. —?

— ? 93. 4. 7. 157. (Type.)

b. *Inner part of the wall incomplete; aperture elliptical.*

156. *Madrepora seriata*.

Heteropora seriata, Ehrenberg, Corallenth. d. roth. Meeres, p. 133.

Madrepora seriata, Dana, Zoophytes, p. 488; M.-Edwards & Haime, Coralliaires, t. iii. p. 152.

Madrepora pallida, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 10, pl. x. fig. A, pl. ix. fig. 6, ? pl. iv. fig. 6.

Madrepora plantaginea, Studer (*non* Lamarek), MB. Akad. Wiss. Berlin, 1878, p. 530 (part.); Studer, Mitth. naturf. Ges. Bern, 1880, p. 19.

Madrepora pyramidalis, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 12 (part.).

Corallum cespitose or cespito-arborescent, flattened above or hemispherical, 10 to 26 cm. broad and 5 to 18 cm. high. Branches 2 cm. thick at the base and 2 to 4 cm. long, or 6 to 9 cm. in cespito-arborescent specimens, much divided in the distal parts. Ultimate divisions 1 cm. thick, usually with a blunt apex. Axial corallites hemispherical, 3·5 to 6 mm. broad; aperture 1 to 1·5 mm. diameter, or in some cases 2 to 3 mm.; both wide and narrow apertures sometimes occur in different parts of the same colony. Radial corallites small, hemicotyloid around the axial corallite, those immediately below usually much appressed and subequal. The majority are short, thick, ascending, tubular, often with the inner part of the wall more or less incomplete and the outer part somewhat convex, 2 to 3 mm. long and broad; outer part of the wall usually thick, margin a little rounded; sometimes a few short, thick, tubular, proliferous corallites occur at intervals, those on the marginal branches are often 5 mm. long. A few smaller, short, nariform or sublabellate corallites with thin walls are scattered between the others and a few are immersed. The star of the radial corallites consists of two cycles of septa, the directives usually, but not invariably, very broad, the others narrow. Corallum rather porous and reticulate above, but denser below; surface spongy-reticulate and echinulate; wall faintly striate.

In one of the type specimens of Ehrenberg the outer part of the wall of the radial corallites is not so thick as usual, and in some cases is quite thin, and in some specimens the branches are much more subdivided than in others.

This and the following species are sometimes very difficult to separate and it may be that both are varieties of one species. *M. pyramidalis* is readily distinguished from *M. seriata* by the form of the branchlets, but there appears, so far as I can judge, to be no constant difference in the corallites.

Indian Ocean: Red Sea, Seychelles, Mauritius, Ceylon, Mergui Archipelago, Great-Barrier Reef, ?Tongatabu.

<i>a.</i> Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 42. (= <i>M. pallida</i> , Klz.)
? <i>b.</i> Tongatabu.	J. J. Lister [P.]. 91. 3. 6. 15. (Young colony.)
<i>c.</i> Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 146.
<i>d.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 147.
<i>e.</i> Troughton Island.	H.M.S. 'Penguin.' 92. 1. 16. 6.

157. *Madrepora pyramidalis*.

Madrepora pyramidalis, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 12, pl. i. fig. 2, ? pl. lv. fig. 6, pl. ix. fig. 7, pl. x. fig. B, pl. ii. fig. 3; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45; Duncan, Journ. Linn. Soc. London, 1886, vol. xxi. p. 20; Ortmann, Zool. JB. 1888, Bd. iii. p. 151 (part.).

Corallum low cespitose or incrusting. Branches pyramidal, rather crowded, so as to become angular below, but conical above, tapering rapidly to a blunt apex; branches little divided unless near the margin of a colony, and budding branchlets are not of frequent occurrence; branches 3 to 4 cm. high and 8 to 10 mm. diameter at a point 1.5 cm. from the apex. Radial corallites much appressed, rather unequal, chiefly with the inner part of the wall undeveloped. In other respects the species agrees closely with *M. seriata*, Ehrb.

Var. *depressa*, Klunzinger, op. cit. pl. ii. fig. 3.

Corallum incrusting, without branches; corallites all short, thick, tubular, those which represent axial corallites recognizable by their larger size. One of Klunzinger's specimens in the Berlin Museum consists of a colony in which the branches at one side are of the usual type, but on the other gradually decrease in length until they reach the incrusting condition of var. *depressa*. The specimens referred by Bassett-Smith to this variety agree with the figure, but form large incrusting masses over an irregular surface of considerable extent. It is, of course, possible that they belong to *M. smithi*, with which they occur on the Tizard Bank; probably in an incrusting condition the two species could not be separated.

Var. *corymbiformis*.

Corallum corymbose with a solid base. Branchlets on the upper surface of the characteristic form, but united together by the solid basal structures, 2 to 3.5 cm. long and about

2 cm. diameter at the base; under surface oblique and solid. Axial corallites 3 to 3.5 mm. diameter. Radial corallites as in typical *M. pyramidalis*.

Indo-Pacific Ocean: Red Sea, Mauritius, Mergui Archipelago, Pelew and Caroline Islands, China Sea, Great-Barrier Reef.

a. Port Denison.

Saville-Kent Coll. 92. 6. 8. 145.

Var. *depressa*.

a, b. Tizard Bank, 2 fath.

H.M.S. 'Rambler.' 89. 9. 24. 99 & 166.

Var. *corymbiformis*.

a. — ?

— ? 93. 4. 7. 110.

158. *Madrepora canaliculata*.

Madrepora canaliculata, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 12, pl. i. fig. 3, pl. iv. fig. 10, pl. ix. fig. 8.

Corallum cespitose, similar to that of *M. seriata*; apical branchlets rarely over 1 cm. in diameter. Axial corallites thick and hemispherical, 4 to 5 mm. diameter. Radial corallites crowded and appressed near the apex, but not dilated. The majority are very unequal; many are 3 to 4 mm. long and 2 mm. diameter, obliquely ascending, tubular, with a more or less deep longitudinal fissure in the inner side, wall not much thickened; others are similar in form but shorter, with spoon-shaped, round nariform, uncinat and immersed ones intermixed. Near the base of the branches the corallites become verruciform and immersed. Corallum porous; surface spongy-echinulate; wall striate.

A specimen in the Saville-Kent Collection has the branches 8 to 9 cm. long and 1.5 cm. diameter at the base; apices about 2.5 cm. apart. Axial corallites 3.5 mm. diameter. Radial corallites spreading almost at right angles, gutter-shaped, half-tubular or obliquely tubular with shorter ones between; a few become stouter and verruciform below, with immersed cells between; length of the more prominent corallites 3 mm., diameter 2.3 mm., margin plane. Septa narrow, especially in the immersed corallites; second cycle often incomplete; the directives usually rather broader than the other primaries.

Indo-Pacific Ocean: Red Sea, Great-Barrier Reef.

a. Port Denison.

Saville-Kent Coll. 92. 6. 8. 200.

159. *Madrepora bullata*. (Plate XIII. fig. D.)

Madrepora bullata, Brook, Ann. Mag. N. H. 1892, vol. x. p. 454.

Corallum cespitose from an incrusting base; diameter 27 cm., height 11 cm., diameter of base 11 cm. Branches digitiform, erect in the centre, spreading towards the margin; central branches 5 to 6 cm. long and about 1.7 cm. diameter at the base, gradually tapering to a blunt apex, simple or forked, with numerous elongate proliferous corallites and short twigs; apices of the main divisions about 3.5 cm. apart, marginal branches on one side

8.5 cm. long, with the subdivisions chiefly on the under surface; nearer the base two or three rows of shorter twigs occur provided with radiating and stout cylindrical corallites with rounded apex (7 to 16 mm. long and 3 to 5 mm. diameter), with or without buds. Axial corallites 5 to 6 mm. diameter, cylindrical, with plane apex when small, but margin strongly curved in all other cases. Wall thick and fenestrated, aperture small, star well developed. Radial corallites tubular, with a more or less oblique aperture, more rarely nariform, increasing in length and diameter from the apex downwards for a distance of about 3 cm., below which a few are more elongate, but the majority short, becoming nipple-shaped and dilated nearer the base, none are completely immersed on the branches. Diameter of the small periaxial buds 1 mm., of an average corallite 1.8 mm., of the more elongate ones below 2.5 mm.; length 1 mm., 2.5 mm., and 5 mm. respectively; the majority have the inner part of the wall a little thinner than the outer and the margin is plane; in the stout elongate corallites the wall is of uniform thickness and the margin more or less rounded. The angle formed by the corallites increases towards the middle of the branches and in a few cases approaches 90°. The star is very well marked in all but the younger corallites and consists of a well-developed primary series of septa and a more or less prominent second cycle. Corallum moderately porous; surface reticulate; wall striate and echinulate.

The type specimen is similar in appearance to certain specimens of *M. canaliculata*, but differs in the complete absence of dimidiate corallites and in the much better developed star.

Pacific Ocean: Great-Barrier Reef area.

a. Port Denison.

Saville-Kent Coll. 92. 6. 8. 238. (Type.)

160. *Madrepora globiceps*.

Madrepora globiceps, Dana, Zoophytes, p. 454, pl. xxxiv. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 153; ? Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16; ? Verrill, Proc. Essex Instit. 1866, vol. v. p. 23; *ibid.* 1869, vol. vi. p. 100.

Corallum broad cespitose, convex above, 30 cm. broad and 15 cm. high, with a solid disc-shaped base. Branchlets erect, digitiform, crowded, subangular, about 6 cm. long and 1.3 to 1.7 cm. thick, rounded at the apex. Axial corallites 2 mm. broad, scarcely at all prominent. Radial corallites crowded (the figure shows them rather distant), short tubiform or tubonariform, 1.5 mm. broad, obsolescent below. Aperture oblique and elliptical; wall obsoletely striate; star distinct. (*Dana.*)

A small corymbose specimen in the collection of the British Museum, growing on a species of *Tridacna*, agrees fairly well with Dana's figure of this species, but the apices of the branches are not so obtuse. The branches are 3.5 cm. long and 1 cm. diameter at the base, slightly tapering to a rounded apex; apices about 2 cm. apart. Axial corallites 2.5 to 3.5 mm. diameter, scarcely exsert. Radial corallites tubular, unequal, but nearly all are very short, spreading almost at right angles, immersed below; the more prominent ones are nearly 2 mm. diameter, rarely 2 mm. long; wall thickened, margin not rounded; aperture often

oblique. Star well developed, but deep. Corallum very dense; surface reticulate and echinulate; wall striato-reticulate.

Pacific Ocean: Tahiti.

? *a.* — ?

Purchased. 49. 5. 18. 2.

161. *Madrepora platycyathus*.

Madrepora plantaginea, Ortmann (*non* Lamarek), Zool. JB. 1888, Bd. iii. p. 151 (part.).

? *Madrepora* cf. *globiceps*, Ortmann, Zool. JB. 1888, Bd. iii. p. 151 (part.).

Corallum cespitose, branches 8 to 9 cm. long and 1.6 cm. thick, subdivided above, the apices about 1.5 cm. apart. Axial corallites 3 mm. diameter, slightly exsert and a little tapering. Radial corallites ascending, compressed, tubular, but the inner part of the wall is only fully developed in the longer corallites; aperture more or less oval: those which are quite tubular average 5 mm. in length and 2 mm. in diameter; wall thickened and dense, margin distinctly rounded: many are 6 mm. long, distinctly compressed (3 by 2 mm.), and bear two or three small buds near the base; others between are appressed, nariform or labellate, rarely subimmersed. Corallum stony, but still more or less reticulate in section; surface strongly echinulate, wall finely so.

A specimen from the Indian Ocean (*Conrad*), referred doubtfully by Ortmann to *M. globiceps*, probably belongs here, but differs in minor points from the type specimen. The axial corallites are more prominent and may be 2 mm. exsert. The radial corallites are not so large and irregular as in the type specimen, and fewer are proliferous; but all are of the same form, 3 to 4 mm. long, with short or subimmersed ones between.

Indo-Pacific Ocean: Tahiti, Indian Ocean (*Strassburg Museum*).

D. *Wall of radial corallites dense and dilated at the base, but thin at the margin.*

162. *Madrepora botryodes*. (Plate XXXIV. fig. C.)

Madrepora gonagra, Brüggemann (*non* M.-Edwards & Haime), Abh. naturw. Ver. Bremen, 1877, Bd. v. p. 398; Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 575.

Madrepora haime, Brüggemann, loc. cit. p. 575 (part.).

Madrepora botryodes, Brook, Ann. Mag. N. H. 1892, vol. x. p. 454.

The only specimen referred by Brüggemann to *M. gonagra* which has come under my notice is the Rodriguez variety, which he compares to a cauliflower. This specimen does not appear to me to agree with the short description of *M. gonagra* given by Milne-Edwards. With regard to Brüggemann's Mauritius specimen and the type of *M. gonagra* I have to judge of the appearance of both with only the descriptions to guide me. Milne-Edwards uses the expression "calices courts, arrondis et groupés irrégulièrement, de façon à simuler des nodosités." Brüggemann, on the other hand, has the following:—"Charakteristisch für

dieselbe sind die nach aussen nicht scharf abgegrenzten Kelche, welche als einfache Nodositäten des Stammes erscheinen." Apparently the simple verruciform protuberances of Brüggemann are quite distinct from the clustered corallites referred to by Milne-Edwards, and I have therefore considered it desirable to give a new name to Brüggemann's form.

Corallum subcespitose, sometimes incrusting a dead colony, probably of the same species; new growth about 3.5 cm. high, diameter of corallum 15.5 cm. Branches erect and crowded, simple or subsimple, 1.2 to 1.5 cm. diameter, but broader at the apex, which is occupied by numerous crowded, proliferous corallites, giving a broad acervate extremity. In old specimens the apices become fused together. Axial and proliferous corallites 3.5 to 5 mm. diameter and 2 mm. exsert, short, cylindrical, with rounded margin and small aperture, usually under 1 mm. Radial corallites appressed, tubular or half-tubular, very variable in size; wall usually thick and frequently dilated; the majority of those situated some distance below the apex are verruciform, with immersed corallites between; the more prominent ones are 2 to 3 mm. diameter, with rounded margin. The star consists of 12 well-developed septa; the directives often nearly meet. Corallum porous; surface reticulate and echinulate; wall armed with closely-arranged dentate plates.

A young specimen 3 to 4 cm. diameter has the branches only 1 cm. long or under; most of the apices are not yet proliferous, and the wall of the radial corallites is usually thin.

Rodriguez.

- a. Rodriguez. Royal Society [P.]. 76. 5. 5. 85. (Type=*M. gonagra*, Brügg.)
- b. Rodriguez. Royal Society [P.]. 76. 5. 5. 88. (Young.) (= *M. haimi*, Brügg.)

163. *Madrepora calamaria*. (Plate XXIII. figs. A, B.)

Madrepora plantaginea, Brüggemann (*non* Lamarck), Phil. Trans. 1879, vol. clxviii. p. 575.

Madrepora calamaria, Brook, Ann. Mag. N. H. 1892, vol. x. p. 455.

Corallum cespitose from a short pedicellate base, or incrusting in the case of young specimens. Colony 21 cm. diameter and 15 cm. high; base 6.5 cm. diameter and 4 cm. high. Marginal branches short and horizontal; middle branches 7 cm. long and 1.5 cm. thick, crowded and angular near the base, divided into 2 or 3 subparallel, digitiform, blunt branches, some of which are again divided; apices about 2 cm. apart, distal divisions 1 cm. diameter, or a little more near the apex, owing to the presence of dilated corallites. Axial corallites 3.5 to 5 mm. diameter at the base, somewhat conical, with a flat apex; aperture rarely over 1 mm. Radial corallites very unequal in size; many are much appressed, dilated tubiform, with the inner part of the wall thin and more or less incomplete, the outer thick, often dilated, but usually rounded so as to be moderately thin at the margin; length 3 to 5 mm., diameter 2 to 2.7 mm.; a large number of the small thin-walled or subimmersed corallites are scattered between the more prominent ones; nearly all become verruciform or

annular and immersed towards the base of the branch. The septa are very narrow, even in the axial corallites; in the radial ones usually only the directives are recognizable. Corallum dense; surface and wall closely echinulate.

Var. *mammillata*. (Plate XXIII. fig. A.)

Two of the Rodriguez specimens consist of incrusting colonies in which the branches are indicated only by conical protuberances, with very numerous and small immersed corallites between. The protuberances are about 7 to 10 mm. high and 6 to 11 mm. diameter, the axial corallites 3.5 mm. diameter; the radial ones crowded, scarcely prominent, with the walls confluent. The larger specimen is 15 cm. long and 8 cm. broad.

Rodriguez.

a. Rodriguez. Royal Society [P.]. 76. 5. 5. 103. (Type = *M. plantaginea*, Brügg.)

Var. *mammillata*.

b, c. Rodriguez. Royal Society [P.]. 76. 5. 5. 86 & 87. (= *M. plantaginea*, Brügg.)

E. Wall of the radial corallites rather thin and firm or slightly thickened, but not rounded at the margin.

164. *Madrepora australis*. (Plate XXIII. fig. C.)

Madrepora australis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 453.

Corallum small caespitose, about 8 cm. high from a base 9 cm. in diameter. Branches usually divided near the base into 2 or 3 erect digitiform branchlets, all of which reach to about the same level, length 3.5 to 4.5 cm., diameter 2 to 2.5 cm. at the base, the distal divisions 1.3 to 2 cm., angular below, slowly tapering to a blunt apex; apices about 2.3 cm. apart. Axial corallites 3 to 4 mm. diameter, hemispherical or a little tapering in the smaller ones. Radial corallites rather distant and unequal, short, spreading, tubular, with more or less oblique apex and plane margin; aperture not compressed, diameter 1 to 2.5 mm., the more prominent ones usually about 2 mm. diameter; length 1 to 2 mm., excepting near the base of the branches, where a few are dilated and others more elongate and less spreading; the wall is a little thickened but not dilated, and the inner part is rarely entirely wanting. A few subimmersed and immersed corallites are scattered between the more prominent ones. Corallum moderately porous; surface spongy and echinulate; wall finely striate and echinulate.

A specimen, the habitat of which is not recorded, is referable to this species, but differs in two or three points. The branches are more acuminate (axial corallites 3 mm. diameter), and the radial corallites in many cases are gutter-shaped, owing to the imperfect development of the inner part of the wall, and sometimes the lip is quite thin. It agrees, however, with the type specimens in the mode of branching and in the spreading unequal corallites, which are not compressed. The species is distinguished from *M. guppyi* by the

mode of branching; by the less crowded, more unequal radial corallites, which are also of greater diameter and are not compressed.

Pacific Ocean: Darnley Island and Great-Barrier Reef.

- | | | |
|-------------------------------------|---|----------|
| a. Darnley Island. | J. B. Jukes, Esq. [P.]. 46. 7. 30. 34. | } Types. |
| b-d. Wreck Bay, Great-Barrier Reef. | J. B. Jukes, Esq. [P.]. 46. 7. 30. 13, 20 & 23. | |
| e. ———? | W. H. Ince, Esq. [P.]. 82. 11. 16. 2. (Var.) | |
| f. Low Woody Island. | Saville-Kent Coll. 92. 6. 8. 124. | |

165. *Madrepora plantaginea*.

Madrepora plantaginea, Lamarck (*non* Dana), Hist. Anim. sans Vert. t. ii. p. 279 (part.), ed. 2, p. 447; Blainville, Manuel d'Actin. p. 390; ? Quoy et Gaimard, Voyage de l'Astrolabe, Zool. t. iv. p. 234, pl. xix. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 149; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42; Ortmann, Zool. JB. 1888, Bd. iii. p. 151; *ibid.* 1889, Bd. iv. p. 504 (*non* Dana, Zoophytes, p. 459; *non* Brüggemann, Phil. Trans. vol. clxviii. 1879, p. 575; *non* Studer, MB. Akad. Wiss. Berlin, 1878, p. 530; *non* Studer, Mitth. naturf. Ges. Bern, 1880, p. 19; *non* Quelch, 'Challenger' Reef Corals, p. 153).

Madrepora variabilis, Ortmann, Zool. JB. 1888, Bd. iii. p. 152 (part.).

A number of specimens which form part of Lamarck's collection in the Paris Museum are labelled *Madrepora plantaginea*, but are referable to at least three species. One is undoubtedly *M. laxa*, and agrees with the type specimen, and another perhaps belongs to *M. retusa*, Dana. The one which I have selected for description appears to be that described by Milne-Edwards.

Corallum cespitose, about 17 cm. broad and 12 cm. high. Branches simple or subdivided, up to 7 cm. long and about 1.4 cm. thick. The majority of the radial corallites are short; but many are thick, tubular, spreading at almost right angles, the more important of which become proliferous and form short spreading branchlets. The terminal 1 to 1.5 cm. of a branch often differs from the lower part in the absence of these proliferous corallites, and the radial ones are more appressed. Axial corallites 4 to 5 mm. diameter, and about 3 mm. exsert; wall thick, margin rounded, aperture about 1 mm. Proliferous tubular corallites and branchlets 3 to 13 mm. long, 2 to 4 mm. diameter or more, with rather thick wall. Radial corallites 1.5 mm. diameter; wall rather thin, 2 to 3 mm. long; they are appressed tubular above, but soon become shorter, and many are almost immersed at a point 2 cm. from the apex, but still with the prominent proliferous corallites between them. The septa of the axial corallites are in two cycles, both rather narrow; in the radial corallites there are also two cycles, but the directive septa are more prominent. Corallum porous; surface spongy-echinulate; wall substrate or echinulate in irregular longitudinal rows.

Two other specimens, which are possibly referable to the same species, have fewer and shorter spreading proliferous corallites, and thus the branches have a more regular appearance. The radial corallites are mostly short, with the inner part of the wall thin and rudimentary, the outer part thickened a little, and the margin rounded. Certain corallites,

by an increase in the thickness of the inner part of the wall, become tubular and spreading (2.5 mm. diameter and 2 mm. long). The more important of these bear lateral buds.

A specimen from Samoa (*Mus. Godeff.*) in the Strassburg Museum, referred by Ortmann to *M. variabilis*, appears to me to approach Lamarck's types more closely than any other specimen which has come under my notice; but the axial corallites are smaller, 3.5 to 4 mm. diameter. The colony is cespitose, with stunted horizontal marginal twigs up to 2 cm. in length and 6 or 7 mm. thick. The central branches are 1.5 cm. thick, and divided near the base into three or more arched branchlets, 6 cm. long and 1.5 cm. thick, which are again much divided and proliferous. Radial corallites very unequal, short and rather spreading tubular near the apex, with short-lipped and small immersed ones between. Most of the prominent corallites are 2 mm. diameter and 1.5 to 2.5 mm. long; wall a little thickened; aperture somewhat oblique, and occasionally the inner part of the wall is very short. A little below the apex a number of tubular corallites extend almost at right angles, and are 4 or 5 mm. long and 2.5 mm. thick, with buds at the base. In this situation the remaining corallites are very short, and on the main divisions nearly all are immersed, with a few short, thick, spreading tubular ones between. Directive septa prominent, the others delicate and often narrow.

Indo-Pacific Ocean: Tahiti, Samoa, Tongatabu, Singapore, Ceylon.

166. *Madrepora erythræa*.

Heteropora abrotanoides, Ehrenberg, Corallenth. d. roth. Meeres, p. 113.

Madrepora erythræa, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 14, pl. iii. fig. 5, pl. iv. fig. 8, pl. ix. fig. 10; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45.

Corallum cespitose, flattened or hemispherical, 10 to 20 cm. broad and 8 to 12 cm. high. Branches digitiform, with numerous short proliferations, 2 to 7 cm. long and 8 to 10 mm. thick, tapering a little towards the apex; outer branches almost horizontal, free or with a few fusions, and provided with distant long tubular corallites on the under surface. Axial corallites 3 to 4 mm. broad and 1 to 1.5 mm. high. Radial corallites always with the inner part of the wall undeveloped, 2 to 4 mm. long and 2 to 2.5 mm. broad; wall rarely thickened, outer part of the wall usually convex.

In the variety *cymbæformis* the majority of the radial corallites are long, boat- or trough-shaped; in variety *cochleariformis* (Ehrenberg's type) shorter and broader with rounder aperture, generally spoon-shaped. Near the base of the branches the corallites become verruciform and immersed. Corallum rather dense within, but porous near the surface; surface spongy-reticulate or compact, echinulate; wall substriate.

The specimens which I have referred to this species agree closely with Klunzinger's description in most respects, but all have a number of the corallites with a more or less complete inner wall, and in one specimen there are many which are tubular with an oblique aperture.

Indo-Pacific Ocean: Red Sea, Maldivé Islands, Mauritius, Great-Barrier Reef.

a-c. — ?

— ? 93. 4. 7. 134, 135, & 165.

<i>d-j.</i> Red Sea?	Purchased. 40. 5. 7. 27 to 29, 31 to 33 & 8
<i>k, l.</i> Wreck Bay, Great-Barrier Reef.	J. B. Jukes, Esq. [P.]. 46. 7. 30. 7 & 35.
<i>m.</i> Maldive Islands.	Purchased. 86. 11. 22. 9.

167. *Madrepora guppyi*. (Plate XXIII. fig. D.)

Madrepora guppyi, Brook, Ann. Mag. N. H. 1892, vol. x. p. 458.

Corallum broad, flattened, cespitose; base 17 cm. diameter, height about 7 cm.; marginal branches subhorizontal, rather small and crowded; the others simple or subsimple, conical, the central ones erect, those nearer the margin radiating; apices rather far apart, often 4 cm. or more; diameter 2 to 2.5 cm. near the base, length 4 to 6.5 cm., regularly tapering to a blunt apex. Axial corallites 3.5 to 5 mm. diameter, hemispherical or scarcely exsert. Radial corallites small, very crowded and spreading, regular, subequal and usually thin-walled, frequently a little compressed, half-tubiform with a rounded apex, or gutter-shaped, or a few with curved lower wall are cymbiform; length 1.5 to 2 mm., diameter 1.2 to 1.5 mm.; those situated near the apex of a branch are shortest, those below gradually become longer and stouter; a variable number of immersed corallites are scattered between the others; near the base of some of the branches the corallites are thickened and may be 2 mm. diameter. The apex of a branch in several cases forms the habitation of a Cirripede. Star not well developed in the radial corallites, often only the directive septa are recognizable, in the immersed corallites even these are extremely narrow. Corallum dense; surface spongy-echinulate; wall finely striato-echinulate.

Solomon Islands.

a. Shortland Island, Solomon Islands. Dr. Guppy [P.]. 84. 12. 11. 18. (Type.)

168. *Madrepora bæodactyla*. (Plate XIII. figs. A, B.)

Madrepora seriata, Brüggemann (*non* Ehrenberg), Phil. Trans. 1879, vol. clxviii. p. 575.

? *Madrepora haimeii*, Brüggemann (part.), loc. cit. p. 575.

Madrepora bæodactyla, Brook, Ann. Mag. N. H. 1892, vol. x. p. 453.

Corallum low, flattened cespitose from a broad incrusting base. The largest specimen is oval and measures 20 cm. by 14 cm., and is 5 cm. high. Branches erect, digitiform, simple or proliferous, the marginal ones oblique, apex blunt or conical; length 3 to 4 cm., diameter 7 to 10 mm.; in some specimens the majority of the central branches are simple, in others divided into 2 to 6 more or less radiating twigs. Axial corallites 2 to 3.5 mm. diameter, scarcely exsert or short and tapering, margin much rounded. Radial corallites chiefly open-nariform or gutter-shaped with an oblique apex, lower border of the wall almost horizontal; length 1.3 to 2 mm. rarely more, diameter 1.6 mm., becoming shorter and subimmersed below. Wall usually thin and margin not rounded, but in one specimen from Rodriguez, which does not differ in other respects, the wall is thicker, the aperture correspondingly smaller, and the margin somewhat rounded (fig. A). In another Rodriguez specimen the radial

corallites are chiefly ascending, and numerous small ones are scattered between those which are most prominent. Star scarcely recognizable or not prominent. Corallum rather dense; surface reticulate and echinulate; wall striato-echinulate, but the striæ become lost as the wall increases in thickness.

This species resembles *M. australis* in the form of the corallites.

Indo-Pacific Ocean : Rodriguez, Great-Barrier Reef.

<i>a, b.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 285 & 286.	} Types.
<i>c, d.</i> Rodriguez.	Royal Society [P.]. 76. 5. 5. 101 & 106. (= <i>M. seriata</i> , Brügg.)	
<i>? e.</i> Rodriguez.	Royal Society [P.]. 76. 5. 5. 107. (= <i>M. haimeï</i> , Brügg., part.)	

169. *Madrepora leptocyathus*. (Plate XVI. fig. C.)

Madrepora leptocyathus, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 463.

Corallum flattened vasiform, from a broad base, not pedicellate. Marginal branches oblique, fused into a solid plate below, excepting near the periphery, where they are a little flattened and covered with short, crowded, appressed, tubular corallites with a thin wall. On the upper surface all the branchlets rise from a solid base with very numerous immersed corallites. The branchlets are about 3 cm. long and 1 to 1.4 cm. thick, frequently angular below, but more tapering above; the apices are usually 1.7 cm. apart. Those in the centre are chiefly simple, but may bear a few proliferous corallites; others, particularly near the margin, are divided. Axial corallites 2.5 to 3 mm. diameter, cylindrical, scarcely exsert. Radial corallites small, crowded, tubular or tubo-labellate, spreading at right angles, wall thin and porous; they are 1.5, rarely 2 mm. diameter, and seldom over 2.5 mm. long, a little unequal, with small and delicate ones between. On the lower parts of the branchlets the prominent corallites are not so numerous and the wall is thickened. Proliferous corallites 5 mm. long and 4 mm. wide (including the lateral buds). Star usually indistinct, but the directive septa are sometimes prominent. Corallum rather dense; surface finely reticulate and echinulate; wall striato-echinulate.

The type specimen appears to consist of two circular colonies fused together.

Samoa.

a. Samoa. Rev. S. J. Whitmee [P.]. 75. 10. 2. 7. (Type.)

170. *Madrepora brevicollis*. (Plate XXVII. figs. A, B.)

Madrepora brevicollis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 454.

Corallum cespito-arborescent, or subcorymbose and oblique; branches 8 to 12 cm. long in the bushy form, 1.5 cm. thick; in oblique specimens the branches may be 22 cm. or more in length, but do not increase correspondingly in thickness. In bushy specimens the branches

are much divided and bear numerous spreading twigs and short proliferations. In specimens which extend obliquely the marginal branches closely resemble those of the cespitose form, but the central ones are suberect, arcuate, distinctly tapering, and not so proliferous. Axial corallites 3 to 4 mm. diameter (but not so stout on the smaller twigs), short cylindrical, margin often a little rounded. Radial corallites much crowded, irregular, chiefly half-tubular or short-labellate, with rounded or plane apex, sometimes distinctly compressed; in some specimens the form is more nearly nariform, or, if the inner part of the wall is at all prominent, tubo-nariform, but in most specimens the inner part of the wall is not developed; diameter usually 1.5 mm., more rarely 2 mm., with a few immersed cells scattered between. The corallites usually remain more or less prominent quite to the base of the branches unless on the under surface of oblique specimens. Star very prominent, but sometimes consists of only 6 septa. Wall moderately thin and porous in the majority of cases, but the outer part is distinctly thickened in the stouter corallites. Corallum porous; surface spongy-reticulate and echinulate; wall striato-reticulate when thin, striate and echinulate if thicker.

Var. *pustulifera*. (Plate XXVII. fig. B.)

Madrepora pustulosa, Brüggemann (non M.-Edwards & Haime), Phil. Trans. 1879, vol. clxviii. p. 574.

A variety which exhibits the same variations in habit as the type, and differs chiefly in the form of the radial corallites, the majority of which are tubular with a somewhat oblique aperture; wall thin and striate as in the type.

Indo-Pacific Ocean: Torres Straits and Great-Barrier Reef area, Rodriguez.

<i>a-c</i> . Thursday Island.	Saville-Kent Coll. 92. 6. 8. 248 to 250.
<i>d</i> . Warrior Island.	Saville-Kent Coll. 92. 6. 8. 252.
<i>e</i> . Palm Island.	Saville-Kent Coll. 92. 6. 8. 253.
<i>f-h</i> . Low-Woody Island.	Saville-Kent Coll. 92. 6. 8. 254 to 256.
<i>i</i> . Rocky Island.	Saville-Kent Coll. 92. 6. 8. 257.

Var. *pustulifera*.

<i>a-f</i> . Rodriguez.	Royal Society [P.]. 76. 5. 5. 94 to 98 & 100. (= <i>M. pustulosa</i> , Brügg.)
<i>g</i> . Thursday Island.	Saville-Kent Coll. 92. 6. 8. 251.

DIVISION III.

7. Subgenus CONOCYATHUS. *Johnson*

Corallum corymbose, cespitose, bushy, subarborescent or reticulate, differing chiefly from *Tylopora* in having more slender apices to the branches and relatively small conical axial corallites with rounded apex. The prominent radial corallites have a dense wall with the margin rounded. The *M. variabilis* group shows an approach to *M. brueggemanni* var. *uncinata* in the form of the radial corallites, but not in habit. The *M. polymorpha* group leads to the form characteristic of *M. rosaria* and its allies.

A. *Corallum corymbose, with or without confluent branches. If the central branches are long the habit is bushy.*

171. *Madrepora variabilis*.

Madrepora variabilis, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 17, pl. i. fig. 10, pl. ii. figs. 1 & 5, pl. v. figs. 1 & 3, pl. ix. fig. 14; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45; Ortmann, Zool. JB. 1888, Bd. iii. p. 152 (part.); ibid. 1889, Bd. iv. p. 505.

Madrepora coalescens, Ortmann, Zool. JB. 1889, Bd. iv. p. 509, pl. xiii. fig. 5.

Corallum very variable in form, bushy, cespitose, corymbose or horizontal and then cespito-foliate with frequent fusions. Outer branches of the colony usually more or less horizontal, almost without corallites below. Axial corallites 3 to 4 mm. broad, little exsert, wall thick, margin rounded. Radial corallites chiefly tubular with a rounded margin, but the inner part of the wall may be much shorter than the outer, aperture small and rarely central. A few of the more elongate ones bear buds and a few very short thin-walled and subimmersed ones are scattered between the others. Lower down the corallites are less spreading, shorter, but rarely immersed. Corallum dense and compact; surface scarcely porous, finely echinulate; wall echinulate, sometimes in rows, but not costulate. The upper corallites are often very spreading, but in other specimens rather appressed, a little unequal, 4 to 5 mm. long and 2 to 3 mm. broad.

Forma *tumida*, Klz.

A small cespitose form with stout dilated radial corallites 3 to 4 mm. broad, closely resembling those of *M. hemprichi*.

Forma *pachyclados*, Klz.

Corallum corymbose, cespito-foliate; branches and branchlets little spreading, 1 to 1.5 cm. thick or more in the case of the main divisions. Radial corallites usually somewhat appressed.

Forma *leptoclados*, Klz.

? *Madrepora* aff. *tenuispicata*, Ortmann, Zool. JB. 1888, Bd. iii. p. 153.

Corallum cespito-foliate or bushy. Branches and branchlets only 5 to 10 mm. thick, but the main divisions may be as stout as in var. *pachyclados*. The elongate tubular corallites and the twigs produced from them are very spreading, the other radial corallites may be spreading or moderately appressed.

Forma *coalescens*.

Madrepora coalescens, Ortmann, Zool. JB. 1889, Bd. iv. p. 509, pl. xiii. fig. 5.

Corallum corymbose, upper surface flattened or a little convex. The branches on the

under surface are fused into an almost solid plate, with a few short conical branchlets pressed into the general plane; surface naked, but with a few immersed corallites. The branchlets on the upper surface are erect and proliferous, 1 cm. thick, and vary in different specimens from 3 to 10 cm. in length. Axial corallites hemispherical, 3 to 4 mm. diameter. Radial corallites nariform, with, towards the apex, a few tubular ones interspersed, which represent new proliferations; they are 2 to 4 mm. long and 2 mm. broad at the apex; wall thick, especially in the upper ones; aperture round or oval, not large. Near the base of the branches immersed corallites are numerous, and a few are scattered between the prominent ones to near the apex. (*Ortmann*.)

Ortmann remarks that the species resembles *M. variabilis*, Klz., but that it differs in the complanate under surface and in the nariform rather than tubular radial corallites. There are, however, many tubular corallites with a slit-like or oblique aperture in the type specimens, and, seeing that the habit of *M. variabilis* is so varied, I think this form should rank only as a variety. On the other hand, one specimen in the Jena Museum labelled *M. coalescens*, var., appears to be more nearly allied to *M. ceylonica*.

Indo-Pacific Ocean: Red Sea, Ceylon, Macclesfield Bank, Great-Barrier Reef, Samoa, Tongatabu.

Forma *pachyclados*.

<i>a.</i> Koseir, Red Sea.	Dr. Klunzinger [C.] 86. 10. 5. 6.
<i>b.</i> Tongatabu.	J. J. Lister, Esq. [P.] 91. 3. 6. 11.
<i>c.</i> —?	—? 58. 2. 10. 5.
<i>d.</i> Capricorn Islands.	Saville-Kent Coll. 92. 6. 8. 216.
? <i>e-h.</i> Macclesfield Bank, 13 fath.	H.M.S. 'Penguin.' 92. 10. 17. 67 to 70.
? <i>i.</i> Macclesfield Bank, 18 to 28 fath.	H.M.S. 'Penguin.' 92. 10. 17. 66.

Forma *leptoclados*.

<i>a, b.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 217 & 218.
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Forma *coalescens*.

<i>a-k.</i> Ceylon.	Haeckel Coll. 92. 12. 5. 9 to 16, 22, 24 & 32.
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172. *Madrepora ceylonica*.

Madrepora ceylonica, Ortmann, Zool. JB. 1889, Bd. iv. p. 506, pl. xli. fig. 3.

Madrepora remota, Ortmann, loc. cit. p. 510, pl. xiii. fig. 6.

? *Madrepora valida*, Ortmann, loc. cit. p. 506.

? *Madrepora secale*, Ortmann, loc. cit. p. 510.

Corallum consisting of a flattened clump of branches arising from an incrusting base, the peripheral ones horizontal and fused together. Branches angular, 5 cm. long, under 1 cm. thick; these bear below rather distant immersed corallites with a wide aperture (over 1 mm.) and prominent star. Up to a point about 1.5 cm. from the apex the corallites are immersed, with a few bursiform ones interspersed. Near the apex appressed nariform or tubular corallites occur, with somewhat thickened wall, 2 to 4 mm. long and 2 to 2.5 mm. thick, but always with immersed and bursiform ones between. The apex of a branch is frequently occupied by

2 to 5 proliferous corallites 2·5 mm. thick. Axial and proliferous corallites conical, 3 mm. at the base, tapering to 1·5 or 2 mm. at the apex, 2 to 3 mm. exsert. Aperture of the corallites generally round, that of the nariform and tubular corallites usually smaller than in the others. A few axial and proliferous corallites have a slit-like aperture. Cœnenchyma porous; wall finely echinulate, indistinctly striate.

I am inclined to regard the specimens recorded by Ortmann as *M. valida*, *M. secale*, and *M. remota* as varieties of this species, and, at any rate, all have many characters in common. The form referred to *M. valida* is rather cespitose than corymbose, but still shows the marginal branches more or less confluent. The specimens referred to *M. secale* have elongate horizontal branches fused into a plate. The type of *M. remota* differs chiefly in its plate-like habit, in having more distant branchlets, and near the centre of the colony a number of sub-erect, elongate, tubular twigs occur, which may be 2 cm. long, 4 mm. broad at the base, and 2·5 mm. at the apex. If I am correct in regarding this form as a variety of *M. ceylonica*, these elongate tubular twigs must be regarded as axial corallites on which lateral buds have not become developed.

Ceylon; ? Macclesfield Bank.

a, b. Ceylon.

c. Ceylon.

d. Ceylon.

Haeckel Coll. 92. 12. 5. 17 & 31.

Dr. Ondaatje [P.]. 83. 4. 26. 3.

Haeckel Coll. 92. 12. 5. 21. (? *M. remota*, Ortm.)

?*e.* Macclesfield Bank, 18 to 28 fathoms.

H.M.S. 'Penguin.' 92. 10. 17. 78.

173. *Madrepora tumida*.

Madrepora tumida, Verrill, Comm. Essex Inst. 1866, vol. v. p. 21; *ibid.* 1870, vol. vi. p. 102; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

Corallum corymbose, the branches coalescing into a broad massive base, supported by a thick peduncle, the upper surface flattened. Towards the margin the branches spread horizontally, and gradually become loosely coalescent and free; from the whole upper surface arise numerous nearly upright branchlets, which are rather stout, about 5 cm. high, tapering rapidly, and mostly divided into several small secondary branchlets. Radial corallites large, thick, and turgid, somewhat appressed; the cells large, opening upwards, conspicuously stellate, with 12 septa, of which the secondary ones are much the narrowest; two directives nearly reach the middle line. Axial corallites somewhat larger than the radial, exsert, the margin thick, very porous; primary septa equal, secondaries well developed. The cells at the base of the branches are wholly immersed, but have 12 conspicuous septa. On the lower surface there are very few cells; these are very small and wholly immersed. Surface of the cœnenchyma openly reticulate and porous, with spinous granules; exterior of corallites densely covered with small lacerate spines. Breadth of largest specimen 46 cm., height 12·7 cm. (*Verrill*.)

Several fragments of an apparently corymbose specimen appear to belong to this species. The axial corallites are 3.5 to 4 mm., somewhat conical, with a rounded margin. Radial corallites often subimmersed quite to the apex of the branchlets, but the outer part of the wall is usually more or less dilated; the more prominent ones are hemicotyloid, 2.5 mm. long and 2 mm. diameter, the inner part of the wall wanting, the outer thick and rounded at the margin, those near the apex of slender twigs are open nariform, with a comparatively thin wall.

Pacific Ocean: Hong Kong and China (probably South).

a-d. China (probably South). Fisheries Exhibition [P.]. 84. 2. 26. 9, 11 to 13.

174. *Madrepora glauca*. (Plate XXXIV. fig. D.)

Corallum semi-vasiform from a lateral attachment. The branches are short and erect above the base, and gradually become more elongate and oblique towards the periphery; all of them reach to about the same plane. They vary from 4 to 12.5 cm. in length and from 1.2 to 1.6 cm. in diameter; they are arranged in several rows of gradually increasing length, and, although close together, are rarely confluent. The surface of the branches is very dense, and consists of very crowded, blunt echinulations of equal length, so that the surface is smooth to the touch. A thin layer immediately beneath the surface is less dense. The under surface is provided with a few short conical twigs without prominent corallites, and at distant intervals a few immersed corallites occur, which are provided with a very prominent star of 6 or more septa. The branches give rise on the upper surface to short, stout, tapering branchlets, which are rendered irregular by the presence of numerous stout spreading corallites, which become proliferous; length 2 to 3.5 cm., diameter at the base about 1 cm. Axial corallites stout, conical, 4 mm. diameter at the base and 3 or 4 mm. exsert; star well developed, the primary septa subequal. Radial corallites round, open-nariform at first, becoming short, ascending tubular by completion of the inner part of the wall, but decreasing in length and finally immersed or subimmersed at a point about 2 cm. below the apex. The wall is at first of moderate thickness, but becomes thicker in the tubular corallites, which have also a rounded margin. Length of the outer part of the wall (the inner is scarcely free in short corallites) 2 to 4 mm., diameter 1.8 to 2.5 mm.; a few are stouter, more elongate, and spreading, and become converted into new axial corallites. The septa are well-developed in all cases; at first the directives are broader than the other primaries, and the second cycle is rather narrow. Corallum very dense; the corallite-wall is at first closely vermiculate with delicate spines on the ridges, but later becomes covered with crowded, blunt echinulations, like the general surface.

West Australia.

a. West Australia.

Purchased. 86. 2. 26. 7. (Type.)

175. *Madrepora concinna*. (Plate XVII.)

Madrepora concinna, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 460.

Corallum corymbose, 30 cm. broad and 12 cm. high, from a central base, scarcely pedicellate. Under surface of the branches horizontal, much flattened, more or less confluent, 9 cm. long and 2 cm. broad, provided with irregular verruciform and lateral, elongate, tubular, or conical corallites; immersed ones almost absent. Branches on the upper surface 5 to 6 cm. long, 8 to 13 mm. thick, very proliferous. Axial corallites 3·5 mm. diameter at the base, tapering, 3 mm. exsert. Radial corallites very unequal; those at the apex are very short, small, and thin-walled; others immediately below are tubo-nariform or tubular, with a round or oblique aperture, frequently opening inwards; some are 3 to 6 mm. long and 2 to 3 mm. in diameter, spreading, but not at right angles; wall thick, margin rounded; others between are shorter or subimmersed; all are short or subimmersed at the base of the branches. Star not prominent, consisting of narrow directive septa and 4 others, which are rudimentary. Corallum dense; surface and wall finely echinulate.

Indian Ocean: Mauritius and Amirante Islands.

<i>a, b.</i> Mauritius.	Purchased. 78. 2. 4. 3 & 8. (Types.)
<i>c.</i> Etoile Island, Amirante Islands.	H.M.S. 'Alert.' 93. 4. 7. 160.
<i>d.</i> —?	—? 93. 4. 7. 156.

176. *Madrepora loripes*. (Plate VIII. fig. B.)

Madrepora loripes, Brook, Ann. Mag. N. H. 1892, vol. x. p. 459.

Corallum bushy, much divided, with numerous short, stout, arched branchlets, usually devoid of corallites on the inner side. Base incrusting, without corallites; main branches about 14 cm. long and 1·6 cm. thick at the base, laxly divided, each division crowdedly covered with unequal branchlets, which consist of an elongate and thickened tubular corallite, which bears buds laterally and on the outer surface, but not on the inner, excepting on the distal part of those which are over 2 cm. long; length 8 mm. to 4·5 cm., diameter 4·5 to 8 mm. Axial corallites 4 mm. diameter, a little less on the smaller twigs; wall thick, but very porous, margin rounded; star well-developed, but deep, occasionally in very large corallites (5 mm.) a third cycle of septa is present. Radial corallites on the distal 3 cm. of the stouter divisions appressed tubo-nariform to spreading tubular, the angle varying with the size of the corallite and the condition of the inner part of the wall, the smaller ones are 4 mm. long and 1·15 mm. diameter, and cylindrical, often with one or two small bursiform buds; a few similar small corallites also occur between the prominent ones; wall moderately thick and margin slightly rounded, more distinctly so in proliferous corallites. The inner part of the wall is thin at first, but with increase in length becomes as thick as in the other parts. On the lower portions of the branches the majority of the corallites are scattered irregularly, thin-walled, and subimmersed to verruciform and appressed tubiform, with short blunt twigs at intervals

of 1 to 1.5 cm.; these consist of a stout, elongate, axial corallite, provided with nariform buds, excepting on the inner aspect, which is nearly always devoid of corallites, excepting on the distal part of the more elongate branches. Immersed corallites are chiefly confined to the basal parts, and are usually small (0.7 mm.). Star imperfect, usually only the directive septa are recognizable. Corallum porous near the surface, but dense within; surface strongly and closely echinulate; wall echinulate, the echinulations are often arranged in longitudinal rows near the base of the cylindrical corallites situated near the apex, but not in other situations.

Pacific Ocean: Great-Barrier Reef.

<i>a.</i> Green Island.	Saville-Kent Coll.	92. 6. 8. 219.	} Types.
<i>b-d.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 221 to 223.	
<i>e.</i> Rocky Island.	Saville-Kent Coll.	92. 6. 8. 224. (Var.)	
<i>f.</i> Capricorn Islands.	Saville-Kent Coll.	92. 6. 8. 234. (Subcespitose.)	

B. Corallum forming a subcomplanate reticulum, with short twigs on the upper surface.

177. *Madrepora cancellata*. (Plate XXXII. fig. C.)

Corallum prostrate and reticulate; branches about 1 cm. diameter, with postero-lateral conical corallites, which may form twigs 1.5 cm. long and 5 mm. thick. The only other corallites on the under surface of the reticulum are immersed or subimmersed, quite distant and scattered. On the upper surface of the branches the corallites are mostly broad-nariform, with the wall often much thickened and the margin rounded; length 2 to 3 mm., diameter 2 to 2.5 mm. At irregular intervals certain corallites become tubular and proliferous, and may then form arched twigs of variable length up to 2 cm. Axial corallites conical, surrounded by scarcely prominent radial corallites with wide aperture; diameter 3 mm., and 2 mm. exsert; star well developed, the directive septa usually broadest. In the radial corallites the directives are very broad and stout, but all the other septa (usually 10) are quite narrow. Corallum very dense; surface and corallite-wall very closely echinulate.

Louisiade Archipelago.

<i>a.</i> Coralhaven, Louisiade Archipelago, 15 fathoms.	51. 9. 29. 39. (Type.)
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178. *Madrepora pumila*.

Madrepora pumila, Verrill, Comm. Essex Inst. 1866, vol. v. p. 23.

"Corallum low and spreading horizontally near the bottom, the branches spreading from one side of the coral. These are openly reticulated, occasionally coalescent, crooked and irregular, flattened from above, giving off from the sides and upper surface short, irregular, scattered branchlets, many of them consisting only of a terminal cell, with one or two small

lateral ones ; others are slender and angular, an inch or more long, with a few distantly scattered and rather large lateral cells. Terminal corallites somewhat exsert, thick, subconical, being thickened below. Cells with 6 septa and a thick margin. Lateral corallites few, tuberculiform, thickened at base, with a simple tubular lip ; cells but little smaller than the terminal ones, with 6 septa distinct. On the lower side of the coral there are neither cells nor branchlets. Cœnenchyma very porous and open, spongiform, scabrous, without distinct striations even on the corallites. Breadth of coral 5 inches ; height 1·5 ; diameter of larger branches ·28 ; of cells ·05." (*Verrill*.)

Bonin Islands.

C. Corallum cespitose.

179. *Madrepora violacea.* (Plate XI. fig. A.)

Madrepora violacea, Brook, Ann. Mag. N. H. 1892, vol. x. p. 465.

Corallum cespitose or subcorymbose from an incrusting base. Colony about 9 cm. high and 12 cm. in diameter. Branches short, stout, and much divided, 1 to 1·3 cm. diameter at the base, somewhat angular owing to crowding ; main divisions 2·5 to 3·5 cm. long, over 1 cm. diameter at a point 1 cm. below the apex. Axial corallites 2·5 to 3·5 mm. diameter, usually about 1·5 mm. exsert, cylindrical or subconical with a rounded margin, wall dense and thick ; the star consists of two cycles of moderately-developed septa, the directives not appreciably broader than the other primaries. Radial corallites chiefly stout, spreading tubular, with smaller tubular, nariform or subimmersed ones between ; sometimes the stout corallites are arranged in subregular rows with small ones between, at others the small corallites are few and scattered. The stout corallites often have the inner part of the wall a little shorter than the outer and the aperture is then oval, the margin is distinctly rounded, diameter 2 to 2·5 mm., length 2 to 4 mm. ; many of the longer ones bear buds, others form short twigs 6 mm. or more in length. The stout corallites have the directive septa more prominent than the others and one or two cycles may be moderately developed, but in other cases the star is scarcely recognizable. Corallum rather dense ; surface and wall finely echinulate, not striate.

A specimen from the Great-Barrier Reef differs from the type in one or two points. The apex of the stout tubular corallites is often oblique owing to the shortness of the inner part of the wall or occasionally the form may be dimidiate. The septa are better developed than in the type, and especially in the numerous short open corallites near the base of the branches and on the under surface ; the directive septa almost meet in the middle line.

Pacific Ocean : Fiji, Great-Barrier Reef.

a. Fiji.

F. M. Rayner, Esq. [P.]. 62. 2. 4. 31. (Type.)

b. Green Island, Great-Barrier Reef.

Saville-Kent Coll. 92. 6. 8. 294.

180. *Madrepora valida*.

Madrepora valida, Dana, Zoophytes, p. 461, pl. xxxv. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 150; Duncan, Journ. Linn. Soc. London, 1886, vol. xxi. p. 19; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19; ? Ortmann, Zool. JB. 1888, Bd. iii. p. 152 (*non* *ibid.* 1889, Bd. iv. p. 506; *non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 453).

Madrepora verrucosa, M.-Edwards & Haime, Atlas Cuvier's Règne Anim., Zooph. pl. lxxxix. fig. 1; *ibid.* Coralliaires, t. iii. p. 150; ? Faurot, Arch. Zool. Expér. 1888, t. vi. p. 119.

Corallum cespitose; branchlets subdigitiform, very uneven, 7.5 cm. long and 12 to 16 mm. thick, rudely proliferous. Under surface of the outer branchlets flattened and nearly naked. Radial corallites unequal, appressed tubiform, very stout and large, 4 to 8 mm. long and 2 mm. broad; exterior smooth, star rather distinct, the directive septa meet below. (*Dana.*)

In the figure given by Dana the axial corallites are scarcely any larger than the radial ones.

The type of *M. verrucosa*, Ed. & H., could not be found at the time of my visit to the Paris Museum. A specimen from Tongatabu bears that name, but does not conform to the diagnosis given by Milne-Edwards and is nothing like the specimen figured in the Atlas to Cuvier's work. There appears little doubt, judging from the description and figure, that *M. verrucosa* is identical with Dana's species.

Var. *digitata*, Dana (*Madrepora albida digitata*, Gualtieri).

Under this name Dana refers to a fragment in the collection of the Boston Natural History Society, in which the branches are 12 to 16 mm. thick, sometimes acervate with two or more large, stout, scarcely exsert corallites at the apex. Radial corallites uneven and very stout, 3 to 6 mm. long, with a thick lip and small circular aperture, very neatly stellate. The form is figured in Gualtieri's Index Test. Conchyl. on the back of titlepage to part iii.

The Thursday Island specimens are subcespitose, branches 8 cm. long and 1.5 cm. diameter at the base, subdivisions radiating. Axial corallites 3 mm. diameter, tapering, with rounded margin. Radial corallites of the same type, ascending to spreading tubular, 1.5 mm. diameter at first, but rapidly increasing to 2.5 or 3 mm. and to 5 mm. in length, somewhat tapering; a few small subimmersed corallites occur between the more prominent ones. The star consists of 12 septa, all except the directives are rather narrow. Corallum very dense; wall finely echinulate, not striate.

Indo-Pacific Ocean: Fiji, Tongatabu, Torres Straits, ? China Sea, Singapore, Elphinstone Island (Mergui Archipelago), ? Red Sea.

a-c. Thursday Island.

Saville-Kent Coll. 92. 6. 8. 290, 291, & 317.

d. — ?

— ? 93. 4. 7. 118.

181. *Madrepora microphthalma*.

Madrepora microphthalma, Verrill, Comm. Essex Inst. 1869, vol. vi. pp. 83 & 102.

Corallum somewhat arborescent, spreading mostly in one plane. The main trunk gives off branches subpinnately, 1.2 cm. thick, rapidly divergent, usually less than 7 mm. apart. A

few smaller branches rise from front and back of trunk and main branches which do not conform to the general plane. Secondary branches and branchlets arise somewhat irregularly, crowded and strongly divergent above, 7 or 8 mm. diameter, 1.2 to 2 cm. long, rapidly tapering to a subacute apex. Axial corallites 2 to 2.5 mm. diameter and of similar length, with porous but firm wall, lip rounded, and perforated by a very small aperture. Radial corallites very unequal in size and elevation, diverging at an angle of about 45°, tubular, somewhat tapering, truncated a little obliquely at summit and rounded; the wall considerably thickened, especially on the outer side, firm but very porous. Length of corallites 0.5 to 3.7 mm., average about 2.5 mm.; diameter 0.5 to 1.75 mm., average about 1.5 mm.; diameter of largest cell 0.38 mm. Septa of axial corallites well developed, 6 primaries meet in the centre, others shorter; the radial corallites have 6 equal, well-developed septa. Cœnenchyma firm, surface finely echinulate; wall evenly echinulate, not costate. (*Verrill*.)

The specimens which I have referred to this species have the following characters:—Corallum laxly arborescent; branches elongate, 2 cm. thick, scarcely tapering. Sometimes the distal 13 cm. of a branch is simple, in other cases the branches bear short stout branchlets nearly to the apex. Axial corallites scarcely differing in size from the radial ones, somewhat conical, 2.5 to 3 mm. in diameter, with moderately developed primary septa and a rudimentary second cycle. Radial corallites dilated, tubular, with much rounded margin and very small aperture; inner part of the wall often incomplete or absent; length 2 to 3 mm., diameter 1.5 to 2.5 mm.; sometimes adjacent corallites are unequal in length, with a few immersed ones between; primary septa relatively broad, the directives most prominent, second cycle incomplete. Corallum dense, surface and wall closely echinulate.

The habit of this species would appear to indicate an affinity with *Eumadrepora*, but the form of the corallites and density of the corallite-wall render it necessary to associate it with *M. valida* and allied species.

Indo-Pacific Ocean: Loo Choo Islands, Korea, Torres Straits, Ramesvaram.

<i>a, b.</i> Ramesvaram.	Madras Museum. 88. 11. 25. 12 & 93. 4. 7. 152.
<i>c.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 66.
? <i>d-g.</i> China (probably South).	Fisheries Exhibition. 84. 2. 26. 17 to 20.
? <i>h.</i> Tsu-sima, Straits of Korea.	J. F. R. Aylen, Esq. [P.]. 62. 7. 16. 34.
<i>i.</i> —?	—? 93. 4. 7. 169.

D. Corallum subarborescent or bushy, usually with numerous short proliferations.

182. *Madrepora polymorpha*. (Plate XXXI. figs. B to D.)

Madrepora abrotanoides, Dana (*non* Lamarck), Zoophytes, p. 477, pl. xli. fig. 1; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; ? Studer, MB. Akad. Wiss. Berlin, 1878, p. 539; Rathbun, Bull. U.S. Nat. Mus. 1887, vol. x. p. 12.

Madrepora polymorpha, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 466.

Corallum fruticose, spreading ramose; branches 8 to 20 cm. long, usually about 1.5 to 2 cm. thick, gradually tapering; the branches bear numerous branchlets, spreading usually

at an angle of 80° to 90° , and varying in importance from thickened and elongate proliferous corallites to subterete and tapering twigs 4 cm. long and 1 cm. thick. Axial corallites 1.5 to 2 mm. diameter and 0.5 to 2 mm. exsert, wall thick or comparatively thin. Radial corallites compressed nariform or tubo-nariform, unequal, the longer ones becoming tubular and proliferous. Some distance below the apex all become verruciform with a dilated wall, which gradually becomes reduced to a ring-shaped fold. Immersed corallites are usually wanting even in the older parts of the colony, but in one or two specimens, which agree closely in other respects, immersed corallites may take the place of those with a ring-shaped lip. Radial corallites 1.5 mm. diameter or under, and 1.5 to 3 mm. or more in length; aperture oval, wall varying in thickness in different specimens; always thickened some distance below the apex of a branch, and in some cases quite to the apex; in the latter case the wall of the axial corallites is also thickened. The axial corallites are provided with 12 septa, none of which are very prominent; those of the radial corallites are also usually narrow, including the directives; in the corallites situated some distance from the apex the second cycle is almost as well developed as the first. Corallum dense, even near the apex of a branch in most specimens; surface and wall finely and closely echinulate.

The species which Dana referred to *M. abrotanoides* is quite distinct from the type of Lamarck, with which the description given by M.-Edwards agrees closely. The description and figure of Dana agree very well with the species here described and I have therefore placed the name as a synonym. It is possible that more recent authors may have taken Dana's species for the true *M. abrotanoides*, and the synonymy is thus uncertain at present.

There is considerable variation in this species, both in the branching and in the thickness of the corallite-wall. The specimens which have come under my notice fall more or less completely into three groups:—

- a. Branches elongate; corallite-wall thin or only slightly thickened near the apex of a branch, but becoming considerably thickened below. A few immersed corallites may or may not occur near the base of the branches.
- b. Branches shorter and more subdivided; corallites often 2.5 mm. diameter, all with thick wall and rounded lip. No immersed corallites.
- c. Branches thick and stunted, with short branchlets. Immersed corallites extending between the bases of the branchlets to near the apex.

Indo-Pacific Ocean: Malacca, ? Fiji.

a-e. Malacca.	Capt. Belcher, R.N. [P.]	42. 11. 28. 1, 5 & 6; 42. 11. 30. 20 & 25.	} Types.
f, g. —?	—?	40. 5. 15. 23; 41. 2. 23. 30.	
h, i. —?	—?	93. 4. 7. 158 & 159.	

183. *Madrepora forskali*.

Heteropora forskalii, Ehrenberg, Corallenth. d. roth. Meeres, p. 113 (part.).

Madrepora forskalii, Dana, Zoophytes, p. 489; M.-Edwards & Haime, Coralliaires, t. iii. p. 150; Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 17, pl. iii. fig. 6, pl. v. fig. 2, pl. ix. fig. 13.

Corallum forming dense and much-branched clumps 10 to 20 cm. high and 15 to 20 cm.

broad. Stems 2 cm. thick; branches and branchlets ascending, 2 to 10 cm. long and 8 to 12 mm. thick, proliferous and scarcely tapering except near the apex. Axial corallites 3 to 4 mm. broad, 2 mm. exsert, margin a little rounded, aperture 1 mm. Radial corallites 1.5 to 2 mm. broad, 3 to 4 mm. long, usually thin-walled, aperture round or oval, 1 to 1.5 mm. diameter; they are unequal, rather appressed half-tubular, with small subimmersed ones between; others are completely tubular and bear buds; below they are more appressed, or verruciform, and finally immersed. Corallum moderately but not openly porous in section; surface spongy-reticulate and echinulate; wall striate.

Several specimens are in the collection from the Persian Gulf which resemble *M. variabilis* in habit, but have the thinner-walled tubo-nariform corallites of this species. One specimen forms a corymbose clump 38 cm. in diameter.

Indian Ocean: Red Sea, Persian Gulf.

a-d. Persian Gulf.

A. S. G. Jayakar, Esq. [P.]. 91. 1. 13. 5, 8, 22 & 31.

e. — ?

— ? 93. 4. 7. 114.

184. *Madrepora rousseaui*.

Madrepora rousseaui, M.-Edwards & Haime, Coralliaires, t. iii. p. 138.

Corallum small, shrubby arborescent, consisting of tufts of slightly tapering branches up to 11 cm. in length; they are 1 cm. diameter from the base to within 3 cm. of the apex, then tapering gradually to the axial corallite. Each branch bears numerous proliferations, 5 to 30 mm. long, which are prolonged and thickened tubular corallites bearing radial corallites in proportion to their length. Axial corallites 2.5 mm. diameter (M.-Edwards gives 3 mm.), 2 mm. exsert, with thick cylindrical wall. Radial corallites tubular or half-tubular at an angle of about 45°, chiefly 2 mm. diameter and 2.5 mm. long, but many are longer; inner margin often incomplete, wall moderately thick, a little rounded at the margin; those over 2.5 mm. long bear one or two small buds near the base, and thus lead on to more marked proliferations and branchlets. A few immersed corallites are scattered between the others, excepting near the apex of a branch and on the younger branchlets. Septa of the axial corallites in one cycle only, subequal, moderately developed; those of the radial corallites also in one cycle, directives broad. Corallum dense; surface a little pitted and finely echinulate; wall finely echinulate, excepting in the younger corallites, where it is striato-reticulate or fenestrated.

The above description is based on the types in the Paris Museum. A specimen in the collection of the British Museum, which appears referable to this species, has the axial corallites 2 mm. in diameter, the branches gradually tapering through their whole length, and the shorter corallites nariform rather than tubular.

Indian Ocean: Seychelles, Malacca.

a. Malacca.

Sir E. Belcher [P.]. 42. 11. 30. 18.

185. *Madrepora exilis*. (Plate X. figs. C, D.)

Madrepora exilis, Brook, Ann. Mag. N. H. 1892, vol. x. p. 457.

Corallum very variable in form, shrubby arborescent to virgate with short peripheral branchlets, in the latter case closely resembling some specimens of *M. affinis* in habit; others recall the habit of *M. rousseaui*. In virgate specimens the branches are about 25 cm. long and 1.3 cm. thick, not including the branchlets, which vary considerably in length in different specimens. Branchlets usually 1 to 2 cm. long and 6 mm. thick, spreading almost at right angles; they are arranged all round the axis so as to give a bottle-brush appearance; apices about 1 cm. apart. In one specimen the branchlets near the apex are elongate, but most of those below are short, unequal, and tapering. Axial corallites scarcely 2 mm. diameter, 1.5 mm. exsert, subcylindrical, with a well-developed star of 12 septa, the directives rather broader than the others. Radial corallites nariform or tubo-nariform, a little spreading, becoming tubular if proliferous, usually 2 mm. long and 1.5 mm. diameter, wall firm and a little thickened; the star consists of 6 moderately developed septa, the directives rather broader than the others. Between the branchlets the corallites are rarely immersed; the majority have a free ring-shaped border, and a few are nariform. In bushy specimens the branches are shorter, more slender, and much divided, with proliferous corallites and short twigs scattered irregularly over the surface of the subdivisions. Five specimens from the same locality show a gradual transition from the virgate to the bushy form. Corallum rather dense; surface and wall echinulate, not striate, but the echinulations may be arranged in linear series.

Pacific Ocean: Great-Barrier Reef area, China Sea, Arafura Sea.

<i>a-f</i> . Port Denison.	Saville-Kent Coll. 92. 6. 8. 102 to 106 & 310. (Types.)
<i>g-i</i> . Macclesfield Bank, 13 faths.	H.M.S. 'Penguin.' 92. 10. 17. 81 to 83.
<i>j</i> . Evans Bank, Arafura Sea, 10 faths.	H.M.S. 'Penguin.' 92. 4. 5. 6.
? <i>k</i> . Seychelles.	H.M.S. 'Alert.' 82. 10. 17. 170.

186. *Madrepora elseyi*. (Plate XI. figs. E, F.)

Madrepora elseyi, Brook, Ann. Mag. N. H. 1892, vol. x. p. 456.

Corallum cespito-arborescent; branches sometimes relatively long with a cluster of branchlets near the apex, at others short and much divided, resembling *M. brevicollis* in habit. Branches 1 to 1.5 cm. diameter; branchlets and proliferous corallites very numerous and usually acuminate. Axial corallites 2 to 3 mm. diameter, sometimes short cylindrical with a plane margin, more usually a little tapering. Radial corallites ascending tubular, rather crowded, wall thick, margin much rounded (excepting in young corallites), inner part of the wall shorter than the outer and often not quite so thick; length 2 to 4 mm. (average 2.5 mm.), diameter 1.5 to 2 mm.; becoming verruciform and finally subimmersed near the base; those near the apex are relatively elongate and slender; many proliferous corallites

occur at intervals, some of which form twigs, others remain short and nipple-shaped; sometimes quite half the corallites on one surface of a branch bear buds, at others very few. Star well developed, the two directive septa very broad. Corallum dense; surface and wall densely echinulate, not striate, though striato-echinulate when thin.

Pacific Ocean: Torres Straits and Great-Barrier Reef area.

<i>a-g.</i> North Australia.	J. R. Elsey, Esq. [P.] 57. 11. 18. 204, 209, 214 to 218. (Types.)
<i>h-l.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 241-245.
<i>m.</i> North Australia.	Saville-Kent Coll. 92. 6. 8. 246.
<i>n.</i> Rocky Island.	Saville-Kent Coll. 92. 6. 8. 247.

8. Subgenus RHABDOCYATHUS.

Axial corallites stout, cylindrical, the free portion not usually longer than broad; wall thick and dense; margin more or less rounded; star usually 12-rayed. The more prominent radial corallites are also thick-walled and are usually provided with more than six septa; they sometimes also resemble the axial ones in form. The habit is either bushy, fruticose, or flattened and reticulate, with branchlets on the upper surface only. There is sometimes an approach to the bottle-brush form in the arrangement of the twigs, but in such cases, so far as known, the twigs are always longer on one side of a branch than on the other.

A. Corallum bushy, fruticose or subarborescent. Radial corallites of the same form as the axial ones, and some of them are scarcely smaller in diameter.

187. *Madrepora hemprichii*.

Heteropora hemprichii, Ehrenberg, Corallenth. d. roth. Meeres, p. 109.

Madrepora forskalii (part.), M.-Edwards & Haime (*non* Ehrenberg), Coralliaires, t. iii. p. 151.

Madrepora hemprichii, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 6, pl. i. fig. 2, pl. iv. fig. 17, pl. ix. fig. 1; Ortmann, Zool. JB. 1888, Bd. iii. p. 149; *ibid.* 1889, Bd. iv. p. 503 (*non* Haeckel, Arab. Korallen, pl. ii. fig. 6).

Madrepora obtusata, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 7, pl. i. fig. 5, pl. iv. fig. 18, pl. viii. fig. 20, pl. ix. fig. 2; Ortmann, Zool. JB. 1888, Bd. iii. p. 149.

Madrepora variolosa, Klunzinger, Korallenth. d. roth. Meeres, Th. ii. p. 8, pl. i. fig. 6, pl. iv. fig. 16, pl. ix. fig. 3.

? *Madrepora rudis*, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 41, pl. iv. fig. 9.

Corallum laxly arborescent or bushy, erect or oblique, with or without occasional fusions, 15 to 20 cm. high, or more in the case of slender arborescent forms. Branches usually about 1 cm. thick, sometimes elongate and little divided, at others shorter and much branched, tapering somewhat towards the apex. Axial corallites 4 to 5 mm. broad, 3 to

5 mm. long, wall very thick and dense, margin rounded, aperture very small. Radial corallites unequal, very spreading, mostly at right angles or nearly so; the longer ones tubular, 3 to 5 mm. long and 3 mm. in diameter, wall thick, margin rounded, aperture 0.5 mm. or a little over. Between these, numerous smaller, short, cylindrical or verruciform ones occur, but none are completely immersed. In the forms which extend more or less obliquely, the underside has fewer or more distant corallites, often without aperture. Corallum very dense; surface covered with crowded elongate echinulations; wall finely echinulate, not striate. In the axial corallites the star consists of 12 septa, the primaries subequal and the second cycle narrow; in some of the radial corallites a second cycle does not occur.

A. *Var. fortis*, Klunzinger.

Corallum 40 cm. high and wide. Branches 2 cm. thick, bearing numerous spreading branchlets about 2.5 cm. long and 1.5 cm. thick. Axial corallites 5 to 6 mm. thick; radial corallites 4 to 5 mm. long and 4 mm. thick. Many of the most prominent corallites are 6 mm. long and 4 to 5 mm. broad at the base, wall tapering; some bear a few bud-corallites near the base.

B. *Var. obtusata*, Klunzinger.

Corallum laxly arborescent, branches blunt at the apex. Axial corallites 5 mm. diameter, little exsert. Radial corallites rather short and stunted, cylindrical, not conical, 3 mm. broad and 3 to 4 mm. long, forming with the stem a wide acute angle.

C. *Var. variolosa*, Klunzinger.

Corallum laxly arborescent, with ascending digitiform branches. Stem 2 cm. thick, branches 3 to 10 cm. long, 1.5 mm. thick at the base, 1 cm. at the apex. Axial corallites 4 to 5 mm. broad; the majority of the radial corallites are 3 to 5 mm. broad and 3 to 4 mm. long, but a few small verruciform ones are scattered between.

D. *Var. depressa*.

Corallum prostrate (?), with few branchlets and corallites on the under surface. Branchlets on the upper surface arched upwards, 3 to 6 cm. long, 1 cm. diameter, gradually tapering, their apices about 2 cm. apart. Axial corallites 3.5 to 4 mm. diameter, 2 to 3 mm. exsert. Radial corallites spreading tubular, 3 mm. diameter, mostly elongate (3.5 to 6 mm.); some of the longer ones bear a few bud-corallites. The lower part of the branches bears subimmersed corallites and others are completely immersed. A star of 12 septa is distinct in nearly all the corallites.

Judging from his description I am inclined to refer the Ceylon form recorded by Ortmann to this variety.

Indo-Pacific Ocean: Red Sea, Ceylon, Great-Barrier Reef, Solomon Islands.

<i>a.</i> Koseir, Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 7.
<i>b.</i> Red Sea.	—— ? 43. 12. 20. 10.
<i>c.</i> Ceylon.	Haeckel Coll. 92. 12. 5. 23.

Var. *fortis*.

<i>a.</i> Koseir, Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 9.
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Var. *obtusata*.

<i>a.</i> Koseir, Red Sea.	Dr. Klunzinger [C.]. 86. 10. 5. 38.
<i>b.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 144.

Var. *depressa*.

<i>a.</i> Shortland Island, Solomon Islands.	Dr. Guppy [P.]. 84. 12. 11. 22.
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188. *Madrepora tubulosa*.

Heteropora tubulosa, Ehrenberg, Corallenth. d. roth. Meeres, p. 110.
Madrepora tubulosa, Dana, Zoophytes, p. 488; M.-Edwards & Haime, Coralliaires, t. iii. p. 148; Studer, MB. Akad. Wiss. Berlin, 1878, p. 532, pl. ii. fig. 5.

Studer supplies the following particulars of Ehrenberg's type:—

The specimen consists of a branch 15 cm. long and 16 cm. thick, scarcely tapering, apex broken away. Radial corallites stout tubular, elongate, and thick-walled, some are proliferous, with appressed subnariform bud-corallites. On the stouter parts a few immersed corallites are scattered between the others. Corallum very porous, surface echinulate. One of the 'Gazelle' specimens, from New Guinea, has the longest corallites, 8 mm. long and 3.5 mm. thick.

A specimen in the collection from Ponapé has the following characters:—Corallum fruticose, consisting of several (probably over a dozen) stems arising from a base of dead coral; some are 16 cm. long, simple and gradually tapering, others very much divided, and bear much-crowded and proliferous branches, about 11 cm. long and 8 to 12 cm. thick. Axial corallites not larger than the largest radial ones, 3 to 3.5 mm. thick, usually about 2 mm. exsert; wall very thick, margin much rounded, aperture small, rarely circular. The radial corallites vary considerably in different parts of the colony; on the more proliferous twigs they are ascending (angle 45°) tubular, unequal in size, 4 to 7 mm. long and 2 to 3 mm. thick, the stouter ones closely resemble the axial corallites and often bear buds; the others tubo-nariform and until the inner part of the wall attains its full thickness the aperture is not central. Between these, but some distance below the apex, nariform, appressed tubular, subimmersed and immersed corallites occur. On the elongate simple branches the condition

of the terminal 2 or 3 cm. is similar to that already described, but below the elongate corallites are more spreading (often at right angles) and distant, about 7 mm. apart, the largest 1 cm. long and 3 to 3.5 cm. thick, usually bearing buds either around the base or near the apex. Between these a relatively small number of very small nariform subimmersed corallites, with variously directed aperture, occur. Corallum reticulate in section near the apex, but becoming much denser below; surface finely echinulate, sometimes subreticulate. Wall porous and striato-reticulate near the apex of the colony, but in other parts dense and closely echinulate. The septa are in two cycles, both moderately developed excepting in the younger radial corallites.

Another specimen from Malacca agrees closely with Studer's description and figure.

Indo-Pacific Ocean: New Guinea, Caroline Islands, Malacca.

<i>a.</i> Ponapé, Caroline Islands.	Mus. Godeffroy. 81. 11. 21. 9.
<i>b.</i> Malacca.	Capt. Belcher, R.N. [P.]. 42. 11. 30. 28.
<i>c, d.</i> — ?	— ? 93. 4. 7. 91 & 92.

189. *Madrepora hystrix*.

Madrepora hystrix, Dana, Zoophytes, p. 476, pl. xl. fig. 1, pl. xxxi. fig. 5; M.-Edwards & Haime, Coralliaires, t. iii. p. 149; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16; Ortmann, Zool. JB. 1888, Bd. iii. p. 150.

The following particulars are supplied by Dana:—Corallum low fruticose, 10 to 12.5 cm. high and 12 to 15 cm. broad, consisting of several branched stems from the same base. Branches and corallites very divaricate and sometimes reflexed. Axial corallites oblong, 2 mm. broad. Radial corallites unequal, 3 to 8 mm. long, scattered, tubiform or tubonariform; some are obsolescent, others proliferous, stout, but the margin not thick. Independent of the corallites the branchlets are only about 4 mm. thick. Surface finely scabro-striate.

The specimen recorded by Ortmann agrees closely with Dana's description, but the corallites are more crowded than is shown in the figure. The colony is 14 cm. high, divided near the base into four spreading branches about 10 cm. long and 1.2 cm. thick, not including the corallites, the lower parts provided with short tubular, subimmersed and, near the base, immersed corallites. The branchlets are all spreading, those of the lower part of the colony almost at right angles, those near the apex at an angle of 60° to 70°; they vary in length from 9 mm. to 3.5 cm., the stouter ones are 5 mm. thick. The short branchlets consist of an elongate tubular corallite with two to six radiating tubular bud-corallites. At first the bud-corallites have a circular aperture, but the inner part of the wall is not free; later, with the development of the inner wall, the corallites become more spreading. The axial corallites usually have a diameter of 2 mm., but in a few of the more elongate branchlets the diameter may be 3 mm.; the margin is distinctly rounded. Radial corallites tubular and very spreading, 2 mm. diameter and up to 5 mm. long if simple, those which are longer bear buds. Occasionally one which bears only 2 or 3 short buds may be 1.2 cm. long. Corallum rather porous near the apex of the colony. Surface dense and finely

echinulate, but the echinulations are sometimes obscured by the formation of a spongy film on the surface. Wall at first very finely striate, the striæ consist of delicate echinulate plates, but later the striation is lost and the surface is then evenly echinulate.

Pacific Ocean : Fiji and Pelew Islands.

B. Corallum bushy, very closely divided.

- a. *Many of the radial corallites are tubular, others more or less nariform; the margin is only slightly curved.*

190. *Madrepora syringodes*. (Plate XXXIII. fig. E.)

Madrepora cf. durvillei, Ortmann, Zool. JB. 1888, Bd. iii. p. 151.

Madrepora syringodes, Brook, Ann. Mag. N. H. 1892, vol. x. p. 463.

Corallum bushy and much divided, sometimes of the bottle-brush type, with the branchlets longer on one side than the other. In bushy specimens the branches are 8 to 10 mm. thick, much divided, the divisions little spreading, with the apices about 12 mm. apart. Most of the branchlets bear a number of spreading proliferous corallites, which form twigs about 1.5 cm. long and 5 mm. thick at the base but more near the apex. Axial corallites cylindrical, with the margin more or less distinctly rounded, 2.5 to 3 mm. diameter and 2 to 4 mm. exsert. Radial corallites appressed tubular, tubo-nariform or nariform; the diameter, length, and angle vary with the form of the corallites; length 3 to 7 mm., diameter 1.75 to 2.5 mm., the stoutest closely resemble the axial corallites and ultimately bear buds; the majority are 3 or 4 mm. long and 2 mm. thick. The corallum is somewhat porous in section, the surface and wall closely and evenly echinulate. The axial and proliferous corallites possess a star of 12 moderately developed septa, but in the remaining corallites the septa are scarcely recognizable.

This species resembles *M. carduus*, Dana, in many respects. It differs from the specimens referred by Studer to that species in habit, in the stouter tubular corallites, the more spreading and frequently nariform radial corallites, and the presence of the immersed corallites on the main divisions. The corallum is also more porous and the surface is scarcely tabulato-echinulate.

Pacific Ocean : Great-Barrier Reef, Samoa, South Seas.

a. Palm Island.

b. — ?

c. — ?

Saville-Kent Coll. 92. 6. 8. 209.

Mansell Coll. 41. 1. 13. 10.

— ? 93. 4. 7. 163.

} Types.

191. *Madrepora carduus*.

Madrepora carduus, Dana, Zoophytes, p. 464, pl. xxxvi. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 149; Studer, MB. Akad. Wiss. Berlin, 1878, p. 532; Möbius, Beitr. z. Meeresfauna Mauritius, p. 45; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 12.

The following is a summary of Dana's description:—

Corallum arborescent, resembling *M. echinata* in habit, but the branches are more closely subdivided and the corallites are much shorter. Corallum 46 cm. high, 6 to 7·5 cm. wide below and 15 cm. above, where the branches are divided into a large number of closely ascending branchlets. Proliferous branchlets 2·5 cm. long, 2 to 4 mm. thick. Axial corallites tubular, only 2 to 3 mm. exsert; radial corallites appressed tubiform or round-nariform, wall very finely striate.

Studer's 'Gazelle' specimen has the branches 9 mm. thick and the lateral branchlets 1 to 2·5 cm. long. A few, but very few, are simple and tapering; the majority bear short appressed tubular radial corallites. The axial corallites usually bear buds to within 2·5 mm. of the apex; diameter 1·3 mm. at the apex, margin scarcely rounded except in old corallites. Corallum very dense; surface closely tabulato-echinulate; wall finely echinulate.

Indo-Pacific Ocean: Fiji, New Britain, ? Australia, ? Malacca, Mauritius.

? a. Australia.

Sir E. Home, Bart. [P.]. 54. 4. 14. 22.

? b. Malacca.

Sir E. Belcher [P.]. 42. 11. 30. 19.

192. *Madrepora striata*.

Madrepora striata, Verrill, Comm. Essex Inst. 1866, vol. v. p. 24.

"Corallum subarborescent; closely branched and much divided above, covered on all sides with crowded lateral branches, which are much smaller on one side of the trunk, indicating that the coral grew in an oblique or horizontal position. The branchlets on the lower side are numerous, about half an inch long, abruptly spreading, and consist of a cluster of several elongated, leading corallites, with a few smaller lateral ones. On the upper side, towards the end, the branches become from 1 to 2 inches long, slender and much divided, the subdivisions always spreading at a large angle like the branchlets themselves. On all sides of the trunk and large branches, immersed cells occur of rather large size. Terminal corallites elongated, tubular, considerably exsert, the exterior nearly costate, with pores between the ribs; walls but little thickened, cells but little larger than the lateral ones, deep, with 12 narrow septa. Lateral corallites large, open, tubuliform or somewhat cochleariform, opening upwards, not crowded or appressed, the exterior costate; the costæ with minute short spines. Cells large, with a well-marked star of 6 septa, and often with minute ones of the second cycle between; two of the principal septa meet in the middle. Cœnenchyma very firm, with scattered irregular pores, the surface minutely spinulose.

"Height of the largest specimen 13 inches ; diameter of trunk at base 1.5 ; diameter of lateral cells .08.

"This species branches somewhat like *M. carduus* and *M. rosaria*, Dana, but the corallites are entirely different in form." (*Verrill*.)

? Ousima, Japan.

b. *Radial corallites which do not become converted into axial ones are more or less nariform and have the margin distinctly rounded.*

193. *Madrepora rosaria*.

Madrepora rosaria, Dana, Zoophytes, p. 465, pl. xxxvi. fig. 3; M.-Edwards & Haime, Coralliaires, t. iii. p. 138; Quelch, 'Challenger' Reef Corals, p. 162; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 18; Ortmann, Zool. JB. 1888, Bd. iii. p. 150.

Corallum erect, arborescent, 38 cm. high and 10 cm. wide; stem closely subdivided and covered throughout with crowded ramificuli, which are very obtuse, 6 to 8 mm. thick, even at the apex, subterete, often proliferous. Axial corallites 2 to 3 mm. broad, a little exsert. Radial corallites stout and compressed-nariform, with a very thick margin, striate and sometimes subseriate, many are proliferous; star 12-rayed, distinct. (*Dana*.)

The specimens in the collection which appear to be referable to this species are numerous and exhibit considerable variation in habit and in the size of the corallites; they fall into three well-marked groups, the first with two varieties:—

A. *Forma rosaria*.

Stem simple or a little subdivided, or several stems may arise from the same base, which almost invariably consists of dead coral. Branchlets very crowded, varying from simple tapering branchlets 2.5 cm. long and 7 mm. thick to much and spreadingly divided ones 3 to 5 cm. long and 7 to 10 mm. thick; they arise at an angle of about 45°, but as their subdivisions are chiefly on the outer side, the terminal twigs appear at right angles to the stem. The whole corallum has a bottle-brush appearance and varies from 7 to 10 cm. in diameter. Axial corallites 2.5 to 3 mm. broad and 1 to 5 mm. exsert, but usually not over 2 mm.; wall thick and firm, margin plane or rounded; septa in two cycles, the primaries well developed. Radial corallites thick-walled, nariform or tubular, a little compressed or quite round, varying in different specimens; diameter 2 mm., length varying from sub-immersed to 3 mm. or more, the longer ones are proliferous. Usually at a point about 1 cm. from the apex of a twig the corallites become less prominent, and on the stem and stouter subdivisions they are all immersed; the star consists of 12 septa, the directives very broad, the others quite narrow. Corallum very dense, surface and wall finely and closely echinulate. The Ponapé specimens have rather smaller corallites on the apical divisions and the lateral ones are usually distinctly compressed.

α. Var. cespitosa.

This variety differs little from the form already described excepting in habit. The specimens consist of small cespitose clumps 6.5 cm. high and 6 to 8 cm. broad; branches numerous and very crowded, each similar to one of the branchlets in form A. Immersed corallites small and not numerous.

β. Var. diffusa.

Corallum spreading arborescent, 24 cm. high and 27 cm. broad. Branches curved and very spreading, sometimes 18 cm. long and about 1.5 cm. thick, gradually tapering. They bear numerous branchlets at an acute angle, which vary from elongate proliferous corallites to 7 cm. in length, all are under 1 cm. in thickness, and the majority are about 1.5 cm. long. Radial corallites nearly all tubular, but the shorter ones are nariform; a large number are very spreading, about 5 mm. long, and bear two or three bud-corallites; the others are shorter and less spreading and many are subimmersed, but the truly immersed type is not frequent. The star consists of 12 septa, well developed excepting in the short and immersed corallites.

B. Forma pygmæa.

Colony erect arborescent; stem 1 cm. thick, a little divided. Branchlets 1 to 3 cm. long, but chiefly under 2 cm., and 3 to 5 mm. thick; axial corallites not over 2 mm. diameter, with a star consisting of 6 septa only. Radial corallites very variable in length and shape; the short ones are nariform, sometimes compressed, and there are various intermediate forms through dimidiate to tubiform. The diameter varies from 1 to 2 mm., the length from 1 to 3 mm.; the longer ones bear bud-corallites. The wall varies considerably in thickness, often rather thin and only showing a thickness proportionate to that of other varieties in the tubular corallites. Immersed corallites practically absent, their place being taken, on the stems and branches, by appressed nariform or tubular ones. Surface of the cœnenchyma as in the other varieties, but the wall of the corallites near the apex of the colony is substrate.

This is the form recorded by Quelch, and all the 'Challenger' specimens belong to it. It differs chiefly in the more slender branchlets, the much smaller corallites, and the absence of immersed corallites.

C. Forma dumosa. (Plate XVI. fig. A.)

Habit similar to that of var. *pygmæa*, but more bushy, and the twigs are more acuminate. The colony may be 21 cm. high and 20 cm. broad, the upper 12 cm. consisting of a new incrustation over a dead colony. Near the base the branchlets often consist of a thick tapering axial corallite, with scarcely open buds to within 9 or 6 mm. of the apex only; diameter at the apex 1.6 mm., diameter 9 mm. below that point (where the last bud is situated) 2.3 mm.; margin rounded, aperture scarcely recognizable. Nearer the apex of the colony the axial corallites bear buds to within 2 or 3 mm. of the margin, which is then not so

distinctly rounded. The buds are at first nariform, but as the inner part of the wall becomes developed they are more spreading and tubular; length 4 mm., diameter 2 mm., margin scarcely rounded.

Pacific Ocean: Fiji, Samoa and Friendly Islands, Louisiade Archipelago, Great-Barrier Reef, Torres Straits, Caroline Islands.

A. *Forma rosaria*.

<i>a-c.</i> —?	Purchased. 70. 4. 9. 1 to 5.
<i>f, g.</i> Ponapé, Caroline Islands.	Mus. Godeffroy. 81. 11. 21. 10 & 93. 4. 7. 95.
<i>h.</i> —?	—? 93. 4. 7. 96.
<i>i.</i> Port Denison.	Saville-Kent Coll. 92. 6. 8. 94.
<i>j.</i> Palm Island.	Saville-Kent Coll. 92. 6. 8. 95.

Var. *diffusa*.

<i>a.</i> Samoa Islands.	Purchased. 62. 1. 27. 2.
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Var. *cespitosa*.

<i>a-c.</i> Tongatabu.	J. J. Lister, Esq. [P.]. 91. 3. 6. 11, 12, & 13.
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B. *Forma pygmæa*.

<i>a-c.</i> Fiji.	H.M.S. 'Challenger.' 86. 12. 9. 234 & 407 ; 91. 3. 5. 1.
<i>d.</i> Duchâteau Islands, Louisiade Archipelago, 12 fath.	J. Macgillivray, Esq. [P.]. 51. 9. 29. 35.
<i>e-h.</i> Low Woody Island.	Saville-Kent Coll. 92. 6. 8. 107 to 110.
<i>i.</i> Thursday Island.	Saville-Kent Coll. 92. 6. 8. 111.

C. *Forma dumosa*.

<i>a, b.</i> Port Darwin.	Saville-Kent Coll. 92. 6. 8. 205 & 206.
<i>c, d.</i> Palm Island.	Saville-Kent Coll. 92. 6. 8. 207 & 208.

194. *Madrepora hydra*.

Madrepora longicyathus, Ortmann (non M.-Edwards & Haime), Zool. JB. 1888, Bd. iii. p. 150; ? Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41.

Corallum bushy-arborescent; branches 1 cm. thick and up to 10 cm. long, with numerous and crowded branchlets. Branchlets 3 to 4 cm. long, sometimes divided near the base into 3 or 4 radiating twigs, which are usually 6 to 7 mm. thick. Axial corallites 3 mm. diameter, 2 mm. exsert, margin much rounded, aperture very small. Radial corallites usually about 4 mm. long and 2 mm. thick or a little over, appressed tubo-nariform, with a thick wall and rounded margin, so as to give a small aperture in the centre of the upper surface. Certain of the radial corallites are elongate tubular, 2 cm. long and 3 mm. thick, with 1 to 6 small buds near the *distal* extremity. A star of 6 or 12 well-developed septa occurs in the tubo-nariform corallites, the directives are frequently confluent. The

upper surface of the main divisions bears a few swollen appressed corallites with a prominent star, but these are absent from the under surface, which is provided only with tubular twigs. Corallum moderately porous; surface and wall of the corallites closely clothed with elongate slender echinulations.

Ortmann (*loc. cit.*) expressed his doubt as to the identity of the specimen with *M. longicyathus*, M.-Edwards & Haime. It was received through the Museum of Comparative Zoology, and I therefore presume is the species referred to in Verrill's paper quoted above.

The form of the tubo-nariform corallites and the elongate tubular ones with buds near the apex distinguish this species from others of the subgenus.

Singapore (*Strassburg Museum*).

195. *Madrepora orientalis*.

Madrepora rosaria, Ortmann (*non* Dana), Zool. JB. 1888, Bd. iii. p. 150.

Corallum cespitose or cespito-arborescent. In the cespitose variety the colony is 15 cm. high and 23 cm. broad; in the other the height is 28 cm. and the breadth 18 to 20 cm. The branches and branchlets are much divided and very crowded; the main branches are 1 cm. thick or a little over, and 10 cm. long in the cespitose colony, and bear numerous short, proliferous twigs near the base, and more elongate and less spreading ones above, up to 2.5 cm., or in some cases 4.5 cm. long. At the margin of the colony the branches are 1 cm. thick and spread horizontally. Axial corallites 3 to 3.5 mm. diameter, 1 to 2 mm. exsert, wall thick and firm, margin only slightly rounded. The radial corallites are arranged at an angle of about 30° to 35°; the majority are tubular, thick-walled, and a little compressed at first, 3 to 5 mm. long and 2 to 2.5 mm. thick, margin a little rounded; many of these bear two or three bud-corallites; others are wide nariform or short labellate; lower down, the majority are hemicytoid, often a little dilated, and pass gradually into immersed ones with an aperture of 1 mm. Star of the radial corallites imperfect, but the directive septa are more or less prominent, the others rudimentary. Corallum dense, but somewhat reticulate in section; surface dense and finely echinulate, covered in parts with a spongy film; wall finely and closely echinulate, not striate.

Pacific Ocean: Fiji, Ponapé (*Strassburg Museum*).

C. *Main branches complanate and reticulate, with erect twigs on the upper surface.*

196. *Madrepora confraga*.

Madrepora confraga, Quelch, 'Challenger' Reef Corals, p. 159, pl. ix. fig. 6.

The following is a description of the type specimen:—

Corallum extending horizontally; branches much divided, rarely coalescent. Main branch (?) a little compressed, 1.5 cm. thick, becoming divided into three or four branches

8 cm. or under in length and 1 cm. or more thick, not flattened. The under surface bears a number of spike-like, little-divided branchlets, about 2 cm. long, spreading almost at right angles; the corallites on the under surface of the branches are immersed, aperture about 1 mm. The upper surface bears numerous stout suberect branchlets, most of which are much and spreadingly divided, 2 to 4 cm. long and 5 to 7 mm. thick. The majority of the corallites on these branchlets and also on the upper surface of the branches are thick appressed tubular or hemicytoid; sometimes the outer part of the wall is produced into a blunt point; they are 2 mm. diameter and 2 to 4 mm. long, margin usually thick and rounded. Axial corallites tubular, 6 mm. or more in length, 2.5 to 3 mm. thick, tapering to 2 mm. In addition to the axial corallite, two or three near the apex become elongate tubular, very spreading, and bear buds. The star consists of 12 well-developed septa. Corallum very dense; surface and wall finely echinulate. The specimen is a triangular fragment 12 cm. long and 13.5 cm. broad; the apices of nearly all the branchlets are much broken and the surface is worn.

Another specimen in the Collection, from Malacca, is probably referable to this species, although at first sight it differs considerably. It is, however, a much more perfect specimen, a factor which accounts for much of the apparent difference between the two. The stoutest branch is 1.2 cm. thick, and becomes subdivided as in the type, the divisions being 5 to 20 mm. apart, with only one instance of fusion between adjoining branches. The chief variation from the type occurs on the under surface. The branches here are a little flattened and the spike-like branchlets, instead of standing out nearly at right angles, are pressed almost into the plane of the branches as in *M. speciosa* and *M. rambleri*. This has the effect of considerably reducing the thickness of the corallum; this thickness is about 5.5 cm. in the type specimen, in the one under consideration it is only 3.5 to 4 cm. On the upper surface of the branches the appressed tubular corallites are more clearly defined, have usually a thinner wall, and the aperture is large (1 mm.). The distal extremity of each branchlet consists of from two to five radiating and elongate tubular corallites, 7 to 12 mm. long, 3 mm. diameter or over at the base, and rather under 2 mm. at the apex, wall thick, margin rounded, aperture one third of the diameter or less. The tubular corallites bear nariform bud-corallites to within 3 or 4 mm. of the apex. Septa in two cycles, both of which are narrow.

Indo-Pacific Ocean : Fiji, Malacca.

a. Kandavu, Fiji.

H.M.S. 'Challenger.' 86. 12. 9. 244. (Type.)

b. Malacca.

Sir E. Belcher [P.]. 42. 11. 28. 8. (Var.)

197. *Madrepora clavigera*. (Plate IX. figs. A, A'.)

Madrepora clavigera, Brook, Ann. Mag. N. H. 1892, vol. x. p. 455.

Corallum forming horizontal fronds 3 cm. thick, the main divisions of which are reticulately coalescent. Branches sinuous, flattened below, about 1 cm. broad. Corallites on the under surface chiefly marginal, stout tubular, with a rounded apex, rather spreading,

the longest about 8 mm. and provided with 3 or 4 verruciform buds. A few hemicotyloid or subimmersed corallites are scattered between the others. The upper surface of the main divisions is provided with numerous hemicotyloid or appressed tubular corallites arranged irregularly, about 2 mm. diameter, with a wide aperture and star of six narrow septa. The branchlets on the upper surface are erect or suberect, 2 cm. long, and rarely over 4 mm. diameter at the base if simple, but others which are divaricately branched may be 6 mm. thick. Each branchlet consists typically of an elongate and somewhat club-shaped axial corallite bearing buds which are hemicotyloid and irregular near the base, but become tubular above, where from one to four more or less radiating corallites have about the same diameter, and attain to the same height as the axial corallite. Axial corallites 7 to 12 mm. long, greatest diameter 4 to 4.5 mm., margin much rounded, aperture under 1 mm. diameter; in many cases bud-corallites occur within 2 to 3 mm. of the apex; septa moderately developed. Corallum dense; surface finely and closely echinulate, in some parts showing linear series of pits beneath the surface film.

Habitat not recorded.

a-c. — ?

Sir E. Belcher [P.]. 51. 11. 14. 28.

9. Subgenus TRACHYLOPORA.

Axial corallites slender, elongate and cylindrical; margin plane or suddenly contracted, not rounded; wall thin, but usually dense. A second cycle of septa is usually wanting even in axial corallites. Distal parts of the elongate corallites without buds; the latter rarely reach to within 5 mm. of the apex. The form of the corallum in the species known is either of the bottle-brush type, with very numerous radiating twigs, or flabellate and subhorizontal with the elongate corallites and twigs chiefly on the upper surface.

This subgenus is closely related to *Rhabdocyathus*, which has typically a stouter axial corallite with a rounded margin, around which bud-corallites often extend to within 2 mm. of the apex. In *Rhabdocyathus* the axial corallites are also provided with 12 septa. In some respects *M. rambleri* is intermediate between the two subgenera; but although in this species bud-corallites occur nearer to the apex of the axial corallites than is usual, the axial corallites themselves agree in form and diameter with *Trachylopora*, to which it is therefore referred.

A. Corallum of the bottle-brush type.

a. Aperture of the axial corallites not suddenly contracted.

198. *Madrepora echidnæa*.

? *Oculina echidnæa*, Lamarck, Hist. Anim. sans Vert. t. ii. p. 286, ed. 2, p. 457; Deslongchamps, Encycl. p. 575; ? M.-Edwards & Haime, Coralliaires, t. iii. p. 151 (*non* Dana, *non* Ortmann). *Heteropora echidnæa*, Ehrenberg, Corallenth. d. roth. Meeres, p. 111.

The type of Lamarck does not appear to be preserved in the Paris Museum, and his description is too imperfect for purposes of identification. It is therefore uncertain whether Ehrenberg correctly identified Lamarck's species. Ehrenberg's specimen is preserved in the Berlin Museum, and is quite distinct from *M. echidnaea*, Dana, which should probably be regarded as a synonym of *M. rosacea*, Esper. Ehrenberg's species, for which the name is here retained, is closely related to *M. echinata*, Dana, but has shorter branchlets with less spreading corallites, which are also of smaller diameter. The specimen, which probably consists of only the apex of a colony, is 11 cm. long and 1 cm. thick at the base. The radial tubular corallites and branchlets are very slender, a few are 1 cm. long and simple or sub-simple, 1.5 mm. thick at the base and only 0.75 mm. at the apex; the majority are not over 5 mm. long and 1 mm. thick at the base. Those constituting branchlets bear radial appressed tubular corallites which are scarcely free at the apex, but in twigs 1 cm. long there may be one or two which spread at an angle of 30° to 40°. There are no immersed corallites on the main branches as in *M. echinata*, but instead numerous clusters of appressed tubular corallites occur, which vary from 1 to 3 mm. in length. The wall of the corallites is always rather thin at the apex; the margin is not contracted, and the surface is dense and pitted, but not echinulate. The cœnenchyma is vermiform echinulate on the main divisions, and also at the bases of the longer branchlets.

This species differs chiefly from *M. echinata* in the more slender axial corallites and the appressed radial ones.

Habitat of the type specimens not recorded.

? *a.* New Guinea.

Saville-Kent Coll. 92. 6. 8. 301.

199. *Madrepora echinata*.

Madrepora echinata, Dana, Zoophytes, p. 464, pl. xxxvi. fig. 1; M.-Edwards & Haime, Coralliaires, t. iii. p. 147, ? pl. E 1. fig. 4; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 15 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 150; *non* Quelch, 'Challenger' Reef Corals, p. 162).

Madrepora durvillei, M.-Edwards & Haime, Coralliaires, t. iii. p. 148 (*non* Ortmann, Zool. JB. 1888, Bd. iii. p. 151).

Corallum erect arborescent, attaining 60 cm. in height. Stem 3 cm. diameter near the base, terete, laxly branched; branches 8 to 24 cm. long, 6 to 16 mm. thick, terete, slowly tapering and remaining stout to the apex; those up to 10 or 12 cm. long usually remain undivided. The stem and branches are usually covered with innumerable short, branched ramiculi, 1 to 2.7 cm. long, consisting of a cluster of elongate tubular corallites, simple or subdivided, radiating from a common trunk of very variable length. Adjoining ramiculi are subequal, and give to the corallum a bottle-brush appearance, about 6.5 cm. diameter below and 3 cm. above. Tubular corallites 0.4 to 2.4 cm. long, occasionally remaining simple and curved when 2 cm. long or more, but the majority are spreadingly subdivided; the sub-

divisions are simple or bear one, rarely two, short appressed tubular buds. The majority are 1.5 mm. diameter, scarcely tapering, but the more elongate ones are thicker at the base; all are usually a little over 1 mm. diameter at the apex. Margin plane, aperture not contracted; the star consists of six well-developed septa, the directives being very frequently fused together in the middle line; wall rather thin but firm. Corallum dense and little porous, excepting near the apex of a colony; surface dense, pitted in parts, more or less strongly echinulate; wall striate and echinulate, becoming finely echinulate below. The condition of the surface and the prominence or even the presence of striæ on the wall vary considerably in different parts of the same specimen. The corallites on the stem and main branches are immersed, distant, 1 mm. diameter, with the directive septa usually fused together.

I have compared the type of *M. durvillei* with what appear to me to be typical specimens of *M. echinata*, and have been unable to recognize any constant differences which can be considered of specific value. M.-Edwards's figure of *M. echinata* is not typical, and probably should be referred to another species. As a variety, *M. durvillei* may be recognized by the following characters:—1. Cœnenchyma strongly striate and echinulate. 2. Star little developed in the immersed corallites. 3. The aperture of tubular corallites may be slightly contracted.

Pacific Ocean: Fiji, Samoa, Australia, Sulu Sea, Sandwich Islands, Liu Kiu Islands.

<i>a.</i> Australia.	Sydney Museum. 84. 11. 25. 1.
<i>b, c.</i> Pacific Ocean.	G. Holsworth, Esq. [P.]. 91. 11. 5. 1 & 2.
<i>d.</i> —?	Purchased. 43. 3. 6. 129.

200. *Madrepora subglabra*. (Plate XXIX. fig. C.)

Madrepora subglabra, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 470.

Madrepora echinata, Quelch, non Dana, 'Challenger' Reef Corals, p. 162.

Corallum extending in elongate, slender, and oblique or subprostrate branches, closely resembling *M. procumbens* in habit and in the form of the branchlets. Branches 6 to 18 cm. long, 7 mm. diameter, not terete, owing to the swollen bases of the branchlets. Branchlets 1 to 4 cm. long, similar to those of *M. procumbens*, but the corallites are more slender, scarcely over 1 mm. diameter at the apex; margin plane, aperture not contracted; they vary from 4 to 15 mm. in length, the majority are about 7 mm. long, the terminal 3 or 4 mm. being free from budding corallites. The main branches bear a very small number of sub-immersed corallites about 0.7 mm. diameter. The star consists of six septa, the directives being thick and prominent, the others much narrower. Corallum dense; surface almost smooth, excepting near the apex, where it is finely echinulate; wall very finely striato-echinulate at first, the striæ becoming lost later, and subsequently the echinulations as well.

The 'Challenger' specimens referred by Quelch to *M. echinata*, together with another specimen in the Collection, appear to differ from the above in having a slightly more prostrate habit and in the presence of stronger echinulations; but in these the echinulations are much finer and shorter on the inferior surface of the branches.

Var. *rugosa*.

A specimen from the Banda Sea agrees with the types in habit, but the slender elongate corallites are more numerous and more spreading, often 8 to 10 mm. long and only 1 mm. diameter, not tapering. The wall is very thin and fragile, but quite strongly rugose and echinulate near the base; general surface pitted and armed with short erect plates fringed with delicate echinulations.

Indo-Pacific Ocean : Fiji, Banda Sea, ? Singapore.

<i>a.</i> South Seas.	Purchased.	41. 12. 11. 1.	} Types.
<i>b.</i> Singapore ?	Purchased.	39. 11. 11. 12.	
<i>c.</i> Singapore ?	Purchased.	43. 3. 6. 130.	
<i>d.</i> Fiji Reefs.	H.M.S. 'Challenger.'	86. 12. 9. 243.	(= <i>M. echinata</i> , Quelch.)
<i>e.</i> Fiji.	F. M. Rayner, Esq. [P.].	62. 2. 4. 33.	

Var. *rugosa*.

a. Damma Is., Banda Sea. H.M.S. 'Penguin.' 92. 4. 5. 7.

b. Aperture of axial corallites suddenly contracted.

201. *Madrepora longicyathus*.

Madrepora longicyathus, M.-Edwards & Haime, Coralliaires, t. iii. p. 148; ? *non* Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Studer, Mitth. naturf. Ges. Bern, 1880, p. 19 (*non* MB. Akad. Wiss. Berlin, 1878, p. 531; *non* Ortmann, Zool. JB. 1888, Bd. iii. p. 150).
? *Madrepora proluxa*, Verrill, Proc. Essex Inst. 1866, vol. v. p. 22.

Corallum erect, closely resembling that of *M. echinata* in habit, but provided with stouter branchlets and corallites. Main branches 2 cm. diameter near the base, lateral branchlets 4 to 6 mm., sometimes flattened, length up to 2.6 cm.; the more simple ones consist of a single elongate corallite sometimes 1.2 cm. long. The longer branchlets usually bear one or more lateral, subalternate corallites, short nariform at first, but becoming tubular and more spreading with increase in size. The free extremity of a branch always consists of a more or less elongate tubular corallite, tapering a little towards the apex; about 7 mm. long, a little over 2 mm. diameter near the base, and 1.5 mm. at the apex; aperture strongly contracted, with six septa of moderate breadth in all but the youngest corallites, directives a little broader. Corallum only slightly porous; surface finely echinulate, with a variable number of elongate and narrow pits.

The above description is founded on the type specimens in the Paris Museum. The species differs from *M. echinata* in the strongly contracted aperture, the stouter branchlets and corallites, and in the absence of immersed corallites on the stem and main branches.

a. New Guinea.

Saville-Kent Coll. 92. 6. 8. 300.

202. *Madrepora procumbens*. (Plate XXIX. fig. D.)

Madrepora procumbens, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 467.

Corallum prostrate or subprostrate, subdivisions free. Branches up to 16 cm. long and 1 cm. thick, bearing ramificuli 1·3 to 3·5 cm. long, each of which is usually produced from a single tubular corallite by the formation of radial corallites upon it, nariform or tubonariform at first, but becoming spreading tubular, 4 to 9 mm. long. There may be 20 or more on a twig 3 cm. long, radiating in all directions, the longer ones arched and bearing very short nariform buds. The stem and main branches bear a few corallites at irregular intervals, nariform or subimmersed and immersed. The elongate tubular corallites are 2 mm. diameter near the base, and 1·5 mm. at the apex. Apex suddenly contracted; aperture small, enclosing a star of 6 well-developed septa. Corallum dense; surface finely echinulate, not pitted; wall echinulate in rows.

This species comes near to *M. longicyathus*, and may prove to be only a well-marked variety of it. It differs, however, in habit and in the arrangement and number of the corallites on the branchlets; the axial corallites also usually bear buds to within 2 mm. of the apex, whereas in *M. longicyathus* the terminal 7 mm. is usually free. In one specimen the branches extend horizontally, in another obliquely.

South Seas, Fiji.

a. South Seas.	Purchased.	41. 12. 11. 3.	} Types.
b. Fiji.	Purchased.	62. 2. 4. 33.	
c. — ?	Purchased.	43. 3. 6. 131.	

B. *Corallum stout and lax arborescent, with slender spreading twigs resembling those of Section A.*

203. *Madrepora horrida*.

Madrepora horrida, Dana, Zoophytes, p. 472, pl. xxxix. fig. 2; M.-Edwards & Haime, Coralliaires, t. iii. p. 140; Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 16 (*non* B.-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 452).

Corallum large and stout arborescent, divaricately and remotely branched; branches, below, 2·5 to 5 cm. thick, nearly terete, curved, gradually attenuate, throughout very proliferous, with divaricate ramificuli, 2·5 to 6·75 cm. long. Axial corallites about 2 mm. diameter, exsert; wall not incrassate. Radial corallites thin tubiform, divaricate, sometimes recurved, very unequal, some 8 mm. long, many much shorter or obsolescent, others proliferous. Star 6-rayed. (*Dana*.)

A small specimen is in the Collection from Fiji which agrees well with the apical portion of Dana's figure. It has the same appearance as one would expect a young colony of the species to present, but owing to the absence of stout main branches there is at first sight little resemblance to the specimen figured by Dana.

Pacific Ocean : Fiji, ? Arafura Sea.

a. Fiji.	F. M. Rayner, Esq. [P.].	62. 2. 4. 29.
? b. Evans Bank, 15 fath., Arafura Sea.	H.M.S. 'Penguin.'	92. 4. 5. 9.

*C. Corallum flabellate, subhorizontal, with the tubular and proliferous
corallites chiefly on the upper surface.*

204. *Madrepora granulosa*.

Madrepora granulosa, M.-Edwards & Haime, Coralliaires, t. iii. p. 156; ? Duncan, Ann. Mag. N. H. 1884, vol. xiv. p. 197.

Corallum forming flat fronds about 40 cm. broad and 24 cm. high. Branches 6 to 12 mm. diameter, fused into a network with square or elongate open meshes; no free lateral branches excepting an occasional elongate, tapering, tubular corallite in the plane of the frond, and almost without aperture. Posterior surface without corallites, apparently smooth, but in reality clothed with very closely arranged series of small plate-like echinulations; thickness from back of frond to apex of branchlets about 4 cm. The anterior surface of the fused branches is covered with immersed or subimmersed swollen corallites, the more prominent of which are nariform and give a serrate outline to the margin of the branches, recalling the form of an ear of corn. From the anterior surface of this network a large number of branchlets project at right angles or nearly so, but some arise at a narrower angle and are then bent outwards; length about 3.5 cm., nearly all reach the same plane. Some are simple and a little over 4 mm. in diameter, others are thicker and divided into three or four twigs. The axial corallites are elongate, tubular, 2.5 mm. diameter and frequently 6 mm. long, margin rounded, aperture small. The radial corallites are swollen nariform, with a small aperture, at first appearing as inconspicuous dilatations of the coenenchyma, but ultimately attaining a diameter of 2 mm., with the outer part of the wall 3 mm. long. Septa of the axial corallites in two cycles, the second of which is not well developed. In the radial corallites the primary septa are subequal, and the second cycle often wanting. Corallum very dense; surface clothed with closely arranged plate-like or knobbed echinulations.

The above description is based on the type in the Paris Museum. A specimen in the collection of the British Museum consists of a half-saucer-shaped frond 30 cm. across from a rounded base. The erect branchlets on the upper surface are rarely over 2.5 cm. long, and the diameter of the axial corallites is usually 2 mm. The subdivisions of these branchlets are little spreading, and in this respect differ from those of *M. speciosa*, *M. confraga*, and *M. rambleri*, which have a similar habit. The wall of the tubular corallites is finely striate and echinulate.

Indo-Pacific Ocean: Réunion, ? Mergui Archipelago, Louisiade Archipelago.

a. Coralhaven, Louisiade Archipelago, 13 fath. J. Macgillivray, Esq. [P.]. 51. 9. 29. 39.

205. *Madrepora rambleri*. (Plate XXIX. fig. F.)

Madrepora rambleri, Bassett-Smith, Ann. Mag. N. H. 1890, vol. vi. p. 455.

Madrepora fragilis, Bassett-Smith, loc. cit. p. 455.

? *Madrepora longicyathus*, Studer (non M.-Edw. & H.), MB. Akad. Wiss. Berlin, 1878, p. 531.

Corallum prostrate, fan-shaped, from a lateral or shortly pedicellate base, resembling

M. granulosa in habit. Branches 11 cm. long, 7 mm. thick, subterete near the base, but becoming divided into broad, much-flattened divisions, which are more or less completely fused together. The under surface bears stunted twigs on the margins of the flattened branches, pressed into the general plane; they consist usually of a thick, elongate tubular corallite from 8 to 12 mm. long, and 2.5 to 4 mm. thick, usually bearing short appressed tubular to subimmersed corallites; a very small number of immersed corallites are also scattered over the under surface. The upper surface of the flattened branches bears a number of stout nariform or hemicotyloid corallites usually disposed in three or four irregular rows, two of which are lateral and give a serrate outline to the margins; they are 3 to 4 mm. long and 2 mm. thick. From amongst these corallites a large number of slender branchlets extend subvertically, which are 1.5 to 2.5 cm. long and 4 mm. thick at the base; the distal portion frequently consists of 3 or 4 spreading, elongate, tapering, tubular corallites, 7 to 15 mm. long, the larger ones 2.5 mm. diameter at the base and 1 mm. at the apex; some are simple, but the majority bear a few nariform, short labellate or tubular bud-corallites, sometimes to within 1.5 mm. of the apex. The aperture of all the tubular corallites is small, one third the diameter or under; wall rather porous, but the surface is dense; margin plane or slightly rounded, but not suddenly incurved. The septa have a variable development in different parts of the corallum; the primaries are subequal, or the directives may be prominent and the others narrow, and a second cycle may be more or less completely represented. Corallum dense; surface clothed with crowded blunt echinulations, which may be arranged in rows on the walls.

M. fragilis, B.-Smith, is apparently a young form of this species, in which the flattened branches have not yet become fused together.

Var. *minor*.

The variety of *M. rambleri* recorded by Bassett-Smith, but not described, agrees closely with the type in habit, but the whole of the subdivisions are smaller. The chief distinction rests in the branchlets, which are about 1.5 cm. long and bear numerous, rather spreading, tubular, dimidiate or labellate corallites often 4 mm. long and 1 mm. in diameter; the tubular corallites are only 3 to 5 mm. long, scarcely tapering, and rarely over 1 mm. diameter at the base. The wall, particularly of the tubular corallites, is finely striate, the striæ being dentate.

China Sea.

a. Tizard Bank, 26 fath.	H.M.S. 'Rambler.' 89. 9. 24. 152. (Type.)
b. Macclesfield Bank, 27 fath.	H.M.S. 'Rambler.' 89. 9. 24. 153. (Type of <i>M. fragilis</i> , B.-Sm.) Young.
c, d. Macclesfield Bank, 31 fath.	H.M.S. 'Penguin.' 92. 10. 17. 18 & 19.
e. Macclesfield Bank, 20 fath.	H.M.S. 'Rambler.' 89. 9. 24. 72. (Var. <i>minor</i> .)
f. Macclesfield Bank, 18 to 28 fath.	H.M.S. 'Penguin.' 92. 10. 17. 20. (Var. <i>minor</i> .)

206. *Madrepora rayneri*. (Plate VIII. fig. A.)

Madrepora rayneri, Brook, Ann. Mag. N. H. 1892, vol. x. p. 461.

Corallum forming horizontal fronds similar to those of *M. speciosa*, but less confluent and dense. Branches 1 to 1.5 cm. diameter, scarcely flattened; under surface naked, excepting for a few scattered and appressed twigs 1 cm. or more in length, which consist usually of an axial corallite with dilated base, with or without buds. The upper surface of the main branches bears scattered appressed, nariform corallites, with a few immersed ones interspersed. The branchlets on the upper surface are erect or suberect, and vary in importance from elongate and simple corallites to stout branchlets divided near the base into a number of heads, each of which bears several radiating and elongate corallites. The branchlets are usually 2 cm. long, less near the margin and a little more near the proximal ends of the branches, the thickness varies from 3.5 to 7 mm.; the stouter ones, like the main divisions, have appressed nariform corallites near the base. Elongate tubular corallites 1 to 1.6 cm. or more in length, only slightly tapering; 2.5 mm. diameter at the base and usually 2 mm. at the apex; margin suddenly contracted; aperture small. The star consists of 6 well-developed septa; but in the immersed corallites there are 12 septa and one of the directives is usually stouter than the others. Corallum dense; surface very finely and closely echinulate.

The species differs from *M. speciosa*, which is probably its closest ally, in the less tapering tubular corallites with a suddenly contracted apex, and in the less flattened and confluent main divisions.

Pacific Ocean : Fiji.

a-c. Fiji Islands.

F. M. Rayner, Esq. [P.]. 62. 2. 4. 30, 42 & 44. (Types.)

207. *Madrepora speciosa*.

Madrepora speciosa, Quelch, 'Challenger' Reef Corals, p. 163, pl. x. fig. 1.

Corallum shortly pedicellate, spreading horizontally, or slightly concave above; consisting of much-divided and compressed branches, 9 to 10 mm. wide and 4 to 5 mm. thick, which are coalescent so as to form a thin broad plate with numerous meshes. The under surface, where the flattened coalescent branches are seen to form an irregular trellis-work, is almost destitute of corallites: there are a few small immersed ones, chiefly in the line of the fusions, and the branches bear sublaterally a number of twigs, consisting of an elongate tapering tubular corallite with lateral buds, similar to those of *M. rambleri*. The upper surface of the trellis-work is rendered quite irregular by the outgrowth of numerous elongate, tapering, tubular corallites, singly or in spreading clusters, the general direction being at right angles to the branches; some are forked or trifid, others are divided into irregular clusters. They are about 1.5 cm. long, 3.5 mm. diameter at the base when simple, 6 mm. or more when much divided, 1 mm. or in some cases a little over at the apex; they are thus markedly tapering,

and are frequently curved. They usually bear one or two small appressed buds, certain of which become elongate and tubular; such buds are, however, rarely situated near the apex of a corallite. The upper surface of the branches, between the elongate corallites, is occupied by a number of shorter, less spreading, and often appressed corallites, scattered very irregularly, tubular or hemicotyloid in form, with a few subimmersed ones in the lines of fusion. At the margin of the corallum the subdivisions are short and stunted, some of the axial corallites being here 2.5 mm. diameter at the margin and only 2 to 3 mm. exsert; wall very thick. Star distinct, consisting of 6 subequal primary septa and a very narrow second cycle in the marginal corallites, but in other situations less developed, without the second cycle. Corallum very dense; surface finely echinulate; wall closely echinulate, but not in rows.

Some of the specimens have prominent suberect corallites on both sides of the flabellum.

Pacific Ocean: Tahiti, Macclesfield Bank.

a. Tahiti.	H.M.S. 'Challenger.' 85. 2. 1. 13.	} Types.
b. Papeete, Tahiti.	H.M.S. 'Challenger.' 80. 11. 25. 219 (part).	
c. Macclesfield Bank, 32 fath.	H.M.S. 'Penguin.' 92. 10. 17. 17. (Dead colony.)	
d-j. Macclesfield Bank, at various depths between 30 and 41 fath.	H.M.S. 'Penguin.' 92. 10. 17. 21 to 27.	
k. —?	—? 93. 4. 7. 130.	

DIVISION IV.

10. Subgenus DISTICHOCYATHUS.

Madrepore disticha, M.-Edwards & Haime, Coralliaires, t. iii, p. 163.

Corallum more or less distinctly flattened and extending in one plane. Axial corallites compressed, though sometimes not so at first, giving rise to flattened branches with the most prominent corallites confined to the *lateral* margins. The posterior surface is usually not provided with corallites of any kind, and sometimes the anterior surface is also without corallites; at others the anterior surface is more or less arched and bears short corallites chiefly, with occasionally a few which are elongate and form twigs. The corallum is not so much flattened in *M. parilis* and *M. angulata* as in the other species, but the chief divisions arise laterally.

208. *Madrepore elegans*.

Madrepore elegans, M.-Edwards & Haime, Coralliaires, t. iii, p. 163, pl. E 1. fig. 3.

Corallum flabellate, chiefly in one plane. Branches elongate, much flattened, more or less sinuous and with fusions which are more numerous in some specimens than in others;

the flattening takes place in an antero-posterior direction ; the posterior surface is nearly flat and the anterior more or less arched ; 40 cm. long or more, 2 cm. broad, and under 1 cm. thick. Secondary branches lateral, subalternate, 1.5 to 12 cm. long, very much flattened above but more rounded near their bases. All the branches are practically devoid of corallites on the posterior surface ; laterally they bear subalternate, flattened, tubular corallites or simple branches, 0.4 to 4.5 cm. long and 3 to 5 mm. in longest diameter, often only 2 to 2.5 mm. in the shortest ; those over 8 mm. long usually bear a series of small lateral corallites, which at first are immersed, but, with the formation of a wall around them, become half-goblet-shaped or nariform ; some of these in turn become tubular and give rise to new outgrowths. The anterior surface of the corallum bears a number of scattered, subimmersed, and half-goblet-shaped corallites, certain of which at irregular intervals become tubular or subconical and project at right angles to the surface of the flabellum ; these are the only prominent corallites not in the general plane ; they may be 3 to 12 mm. long, 2 mm. diameter at the apex, gradually becoming thickened towards the base. Apex of the axial corallites oval in section, about 2 by 3 mm., upper part of the wall rounded, with an aperture 1 mm. in diameter. The star consists of 12 septa ; the primaries are well developed, the others only slightly prominent. Corallum very dense ; surface with narrow longitudinal furrows, the whole covered with fine echinulations.

The habitat of the type specimen in the Paris Museum is not recorded.

Philippine Islands.

a, b. Manila.

R. Brown, Esq. [P.]. 93. 4. 7. 168 & 171.

209. *Madrepora tenella*. (Plate XXIX. fig. E.)

Madrepora tenella, Brook, Ann. Mag. N. H. 1892, vol. x, p. 464.

Corallum much flattened, flabellate ; allied to *Madrepora elegans*, M.-Edw. & H., but more delicate. Stem and main branches much flattened or only slightly so ; the smaller divisions are usually more or less rounded. Branches 7 mm. broad and rarely over 3 mm. thick, somewhat sinuous, divisions and corallites almost all lateral : fusions frequent and irregular. Simple lateral corallites give rise, by increase in size and the development of buds, to twigs ranging from 5 mm. to 4 cm. in length, the larger one provided with a secondary series of lateral and divaricate twigs. Axial corallites 1 to 1.5 mm. diameter, a little compressed, usually 3 mm. exsert. Radial corallites distant, compressed, nariform at first but soon becoming tubular and very spreading ; diameter 1 mm. ; length 1 to 5 mm. ; those which are longer usually bear distant buds. There are no immersed corallites and the whole of the corallum, excepting the lateral margins of the branches and twigs, is usually devoid of corallites of any kind. The star consists of 6 moderately-developed septa ; aperture a little contracted if circular, but usually elliptical. In some parts of a colony the more delicate twigs bear alternate, short, nariform to subtubular corallites on the lateral margins, which are much closer

together than is usually the case. Corallum very dense; surface subrugose and very finely echinulate; wall striate and finely echinulate.

China Sea.

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|---------------------------------------|-------------------|-----------------|----------|
| <i>a.</i> Macclesfield Bank, 37 fath. | H.M.S. 'Penguin.' | 92. 10. 17. 33. | } Types. |
| <i>b.</i> Macclesfield Bank, 31 fath. | H.M.S. 'Penguin.' | 92. 10. 17. 34. | |

210. *Madrepora inermis*. (Plate XXIX. figs. A, B.)

Madrepora inermis, Brook, Ann. Mag. N. H. 1891, vol. viii. p. 462.

Corallum consisting of slender laxly-divided branches, which probably extend subhorizontally. The branches are about 21 cm. long and 8 mm. thick, somewhat flattened in places and completely or almost completely devoid of corallites on the under surface, forked and divaricately branched; the branchlets are sublateral, 1.5 to 6 cm. long, 4 to 5 mm. thick, scarcely tapering, those under 5 cm. in length are usually simple. In addition to the more noticeable branchlets, there are a few short, lateral, subalternate ramiculi on the stouter branchlets at intervals of about 1 cm., they are 4 to 8 mm. long and 3 mm. thick. Axial corallites 2 mm. diameter, 1 mm. exsert, wall scarcely thickened, with a star of 6 well-developed septa and sometimes traces of a second cycle. Radial corallites very short, spreading tubular, rather distant, often with indications of a subspiral arrangement; length 1 to 2 mm.; diameter the same, but usually 1.5 mm., and the base may be dilated; those near the apex of a branchlet are not so spreading, but the aperture is always rounded; the longest ones are lateral in position and, on becoming proliferous, give rise to the short ramiculi already referred to. Immersed corallites are practically absent. Wall thin but firm; the septa are arranged in a single cycle, the lower directive often much broader than the others. Corallum very dense; surface dense, smooth on the underside, slightly rough but not spinose on the anterior surface of the stouter branches. The wall of the axial and younger radial corallites is roughly costulate and the striations are continued to the cœenchyma, but below the striations are lost on the corallites as well as on the general surface.

South Seas.

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|--------------------------|------------|--------------------|----------|
| <i>a, b.</i> South Seas. | Purchased. | 41. 12. 11. 6 & 7. | (Types.) |
|--------------------------|------------|--------------------|----------|

211. *Madrepora parilis*.

Madrepora parilis, Quelch, 'Challenger' Reef Corals, p. 162, pl. ix. fig. 3.

Corallum spreading more or less horizontally, the branches and branchlets developing continuously in one plane from opposite sides of the larger branches, and nearly of equal size throughout, viz. 5 to 7 mm. thick. Branches round or vertically compressed, closely placed, rarely coalescent, although extending nearly at right angles. Axial corallites cylindrical, 2 to 3 mm. diameter, with moderately thick and porous wall, not rounded at the margin; the star consists of 12 septa, the directives broadest. The radial corallites are wide apart, tubular,

usually very spreading, 1 to 2 mm. diameter and 1 to 4 mm. long ; they are distributed radially, and form prominent series along the lateral borders, but are almost absent from the under surface of flattened branches. The longest corallites, which are usually sublateral in position, give rise to branchlets. The star of the radial corallites consists of a moderate primary series of septa together with a more or less fully developed second cycle. Corallum porous ; surface and wall strongly striate and echinulate.

Two specimens of this species occur in the second collection made on the Macclesfield Bank by Mr. Bassett-Smith, R.N., which are rather more fragile than the type specimens. The tubular corallites are often 4 mm. apart, 2 to 4 mm. long, and 1.5 to 2 mm. diameter ; those on the anterior and posterior surfaces rarely bear buds. Wall rather thin, margin not rounded.

Pacific Ocean : Tahiti, Philippine Islands, China Sea.

<i>a, b.</i> Tahiti.	H.M.S. 'Challenger.' 86. 12. 9. 222,	} Types.
	& 91. 19. 9. 1.	
<i>c.</i> Samboangan.	H.M.S. 'Challenger.' 80. 11. 25. 15.	
<i>d.</i> Macclesfield Bank, 36 to 43 fath.	H.M.S. 'Penguin.' 92. 10. 17. 31.	
<i>e.</i> Macclesfield Bank, 25 to 28 fath.	H.M.S. 'Penguin.' 92. 10. 17. 32.	

212. *Madrepora angulata*.

Madrepora angulata, Quelch, 'Challenger' Reef Corals, p. 160, pl. ix. fig. 5.

Corallum probably lax and spreading arborescent with slender branches. The type specimen consists of a single curved, apparently subprostrate branch, about 17 cm. long and 7 mm. thick near the base, becoming somewhat thicker above, not terete, distinctly angular in places. The branchlets are 2 to 5 cm. long, and 5 mm. diameter at the base, usually attenuate when simple, but scarcely tapering when further subdivided, arising at an angle of about 50°. Axial corallites 2 mm. diameter, scarcely exsert, wall thin but dense. The primary septa are well developed and a narrower second cycle is usually present. Radial corallites not numerous, frequently arranged in linear series, 1.5 to 5 mm. long and about 1.5 mm. thick, tubo-nariform or rostrato-nariform, intermixed with many ascending tubular ones having a round aperture ; the rows are sometimes 4 mm. apart ; the corallites become shorter below, but none are truly immersed. The septa are unequally developed in the radial corallites ; the directives usually become fused together, the remaining 4 of the primary cycle are not very prominent, and a second cycle may be more or less completely represented in rudiment. Corallum dense but reticulate in section ; surface dense and occasionally pitted, finely echinulate in longitudinal lines ; wall more or less distinctly striate and echinulate.

Philippine Islands.

<i>a.</i> Samboangan.	H.M.S. 'Challenger.' 86. 12. 9. 235. (Type.)
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SPECIES INCERTÆ SEDIS.

213. *Madrepora coronata*.

Madrepora coronata, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 38, pl. iv. figs. 6 & 7 (*non* Brook, Ann. Mag. N. H. 1892, vol. x. p. 456).

Corallum flattened corymbiform and pedicellate. Horizontal branches broad and plate-like, with small lateral twigs, which are also flattened and provided with short, subimmersed or immersed corallites; the upper surface of these branches is rounded and, in the middle of the colony, provided only with immersed corallites. Towards the periphery arched branchlets arise on the upper surface, which are 10 to 20 cm. long and provided with lateral twigs, all of which reach one plane. The corallites are rather distant and attain a maximum length of 3 mm., but gradually become immersed below; the inner part of the wall is absent, only the bud-corallites of terminal twigs have a complete tubular wall, and the wall is then thicker. Surface openly striate or tabulato-echinulate, wall rather closely striate. The largest specimen is 1 m. in diameter. Young colonies do not show well the characteristic flattened horizontal branches. (*Rehberg*.)

Nossibé, Madagascar (*Hamburg Museum*).

214. *Madrepora dichotoma*.

Madrepora dichotoma, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 39, pl. iii. figs. 15 & 17.

The colony arises from a solid style-like base, with chiefly dichotomous branches on its upper surface. The branches arise separately from the base. The outer ones have regularly arranged twigs on the outer surface as in *M. aculeus*, Dana. Towards the centre the bud-twigs gradually become less numerous and many of the apices are simple. Corallites rather distant, of medium size, strongly nariform and bent at the apex. Axial corallites only a little larger than the radial ones, cylindrical and prominent. Surface tabulato-echinulate. In corallites with an elongate aperture the lower directive septum is very broad. Immersed corallites scattered towards the middle of the branches, but very numerous below. Colony 25 to 30 cm. diameter and about 20 cm. high. Branches not over 1 cm. thick. (*Rehberg*.)

Pelew Islands (*Hamburg Museum*).

215. *Madrepora gonagra*.

Madrepora gonagra, M.-Edwards & Haime, Coralliaires, t. iii. p. 151 (? *non* Brüggemann, Abh. nat. Ver. Bremen, 1877, Bd. v. p. 398; *non* Brüggemann, Phil. Trans. 1879, vol. clxviii. p. 575).

Corallum forming cespitose tufts, resembling those of *M. plantaginea*, but having short rounded corallites grouped irregularly, so as to appear like nodosities; aperture of the corallites remarkably small. (*M.-Edwards & H.*)

The type specimen could not be found when I visited the Paris Museum, and there is no present means of identifying the species with certainty.

The specimen in the British Museum referred by Brüggemann to this species does not agree with the above description and constitutes the type of *M. botryodes*, mihi.

Habitat not recorded.

216. *Madrepora papillosa*.

Madrepora papillosa, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 42, pl. iii. figs. 12 & 14.

The colony grows on a mother-of-pearl shell and has a broad pedicel, which widens out into a fan-shaped and laxly branched corallum. The twigs all extend in one plane, somewhat slender and bent, and form together a circular flabellum 30 cm. high. The corallites are slender (appressed tubular) and give a dentate outline to the branches. The axial corallites differ little from the radial ones. Corallite-wall longitudinally striate, with dense thornlets on the striæ, which under the lens appear as papillæ; these are distributed over the whole corallum. The species resembles *M. brachiata* and *M. implicata*, Dana, excepting that the corallum is here flabellate. (*Rehberg*.)

Tahiti (? *Hamburg Museum*).

217. *Madrepora parvistella*.

Madrepora parvistella, Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 41; Studer, Mitth. naturf. Ges. Bern, 1880, p. 19.

Corallum arborescent, numerously branched; branchlets spreading, curved, neatly rounded and tapering, about 1·2 cm. diameter and 8 to 10 cm. long. Corallites evenly crowded, very small, short, tubular, opening obliquely upward; exterior costate, scabrous; cells small, broad oval, stellate; 12 septa distinct, the two largest nearly meet in the centre.

Singapore.

218. *Madrepora philippinensis*.

Madrepora philippinensis, Rehberg, Abhand. nat. Ver. Hamburg, 1892, Bd. xii. p. 40, pl. iii. figs. 13 & 13 a.

Corallum similar to that of *M. spicifera*, Dana*, but with small branched twigs instead of simple ones, and the under surface is provided with spreading corallites; the branches also bear many immersed corallites, and the whole corallum differs in structure and presents an appearance like pumice-stone, ending on the corallite-wall as narrow striations. The corallites are mostly hemicotyloid ("schwalbennestartig"), but those near the apex of a twig are more elongate, straight or bent. (*Rehberg*.)

* Rehberg uses the name *M. microclados*, Ehrb.; but compare my account of the Berlin types.

The species appears related to *M. rambleri*, B.-Sm., but the description is too incomplete to allow of a proper comparison.

Philippine Islands (*Berlin Museum* and a fragment in the *Hamburg Museum*).

219. *Madrepora teres*.

Madrepora teres, Verrill, Proc. Essex Inst. 1866, vol. v. p. 20; *ibid.* 1869, vol. vi. p. 102; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

Corallum arborescent; branches 15 to 20 cm. long and 1.2 cm. diameter, slightly tapering, spreading at an angle of about 50°; branchlets slender, rapidly tapering, rounded at the end. Axial corallites small, scarcely prominent, with 6 well-marked septa and 6 rudimentary ones between. Radial corallites small, about 1 mm. diameter, not crowded, arranged evenly on all sides: those towards the end of the branches opening upward, and provided with a small ligulate border; those on the larger branches wholly immersed. Cœnenchyma strongly vermiculate and sharply scabrous. (*Verrill.*)

Pacific Ocean: Ousima (Japan).

? *a.* China (probably South).

Fisheries Exhibition. 84. 2. 26. 4.

220. *Madrepora turgida*.

Madrepora turgida, Verrill, Proc. Essex Inst. 1866, vol. v. p. 19; *ibid.* 1869, vol. vi. p. 101; Rathbun, Proc. U.S. Nat. Mus. 1887, vol. x. p. 19.

"The corallum consists of a cluster of thick, irregular branches arising from a large massive base. The branches are short and turgid, rounded and elevated at the ends, or often dividing into a cluster of short, obtuse branchlets. Lateral corallites irregular in size and position, swollen below, smaller at the ends, appressed, turned in various directions, the summits often incurved; cells opening inward, small, usually showing 6 nearly equal septa. Terminal corallites not much exceeding some of the lateral ones in size, thick, obtuse, but little prominent; cells showing 12 septa, those of the second cycle much narrower than the rest. Surface of the cœnenchyma and exterior of the corallites loosely porous, covered by crowded lacerately divided granules or small spines, with numerous openings between them. Costæ scarcely apparent. Colour of unbleached coral light brownish yellow. Height of the only specimen collected 6 inches; length of branches 3; thickness about .25 inch." (*Verrill.*)

This species appears to be related to *M. glauca*, or may indeed be identical with it, but the description is not sufficiently precise to allow of the point being settled at present.

Loo Choo Islands.

List of specific names incidentally used by various authors, together with others which have not been accompanied by a description.

- M. rudis*, Dana, Zoophytes, p. 459. ?=*M. valida*, Dana.
M. scabricula, Dana, op. cit. p. 468. ?=*M. aspera*, Dana.
M. quadrata, Dana, op. cit. p. 487. ?=*M. securis*, Dana.
M. corymbites, Valenciennes, Comptes Rendus, 1860, t. 1. p. 1008. *Nomen nudum*.
M. flabilis, Valenciennes, loc. cit. p. 1008. *Nomen nudum*.
M. radicans, Valenciennes, loc. cit. p. 1008. *Nomen nudum*.
M. circinata, Valenciennes, loc. cit. p. 1009. *Nomen nudum*.
M. expansa, Valenciennes, loc. cit. p. 1009. *Nomen nudum*.
M. poculenta, Valenciennes, loc. cit. p. 1009. *Nomen nudum*.
M. papillosa, Klunzinger, Corallenth. d. roth. Meeres, Th. ii. p. 9. ?=*M. pustulosa*, Klunzinger, i. e. *M. klunzingeri*, Quelch, the name being preoccupied. If it were quite clear that Klunzinger intended to refer to *M. pustulosa*, Klz., when using the name *papillosa*, it is probable that *klunzingeri* should give place to it.
M. esperi, Rehberg, Abh. nat. Ver. Hamburg, 1892, Bd. xii. p. 39. Name suggested for *M. muricata*, Esper, Pflanzenth. Fortsetz. p. 52, Madr. pls. ix. & xi.
M. edwardsii, Rehberg, loc. cit. p. 33. Name suggested for the specimen figured by M.-Edwards & Haime, Coralliaires, pl. E 1. fig. 4, which is not *M. echinata*.
M. spinosa, Rehberg, loc. cit. pl. iii. fig. 4. Species not described.
M. symmetrica, Rehberg, loc. cit. p. 33. Pelew Islands. *Nomen nudum*.

ADDENDA.

47 A. *Madrepora thurstoni*. (Plate XXXV. fig. A.)

Corallum fastigiate, forming low and broad spreading clumps closely resembling those of *M. ramiculosa*, Dana, which is probably a variety of *M. squarrosa*, Ehrenberg (see p. 65). Colony 48 cm. wide and about 18 cm. high, but the base forms a very broad incrustation on a massive clump of dead coral, and the total height is 32 cm. Main branches nearly 2 cm. diameter, not over 10 cm. long; the marginal ones horizontal and often divided into 2 or 3 branches, which all extend in one plane. On the upper surface of these divisions bi- or trifid arched branchlets occur, the distal twigs of which are about 2 cm. long and 4 to 6 mm. thick at the base, distinctly tapering. The mode of subdivision of the branches agrees very well with Dana's figure of *M. ramiculosa*. Axial corallites cylindrical, 2 to 2.5 mm. diameter and about 1 mm. exsert; wall very porous; margin plane; septa usually 6 in number, subequal, moderately developed. Radial corallites small and immersed or subimmersed on all parts excepting the distal 1.5 or 2 cm. of the branchlets, where they are nariform, round bursiform, or the outer part of the wall may be a little elongate; length 1.5 to 2 mm., diameter 1 mm. or a little over; a few which are stouter and more elongate indicate new outgrowths. The septa are imperfectly developed, usually only the directives are recognizable in the prominent corallites, but in some of those which are immersed the primary cycle may be more complete. Corallum porous; surface reticulate; wall broadly and deeply striate, echinulate towards the base.

Indian Ocean : Ramesvaram.

a. Ramesvaram.

Madras Museum. 88. 11. 25. 9. (Type.)

97. *Madrepora surculosa*, Dana (p. 104).

Descriptions of two varieties of this species recorded by Dana were inadvertently omitted in the text :—

Var. *turbinata*, Dana, Zoophytes, p. 446.

? *Madrepora turbinata*, Verrill, Bull. Mus. Comp. Zool. 1864, vol. i. p. 42.

This variety closely resembles the type in its smaller branchlets; but instead of spreading horizontally and forming a solid or reticulate frond, the branches spread obliquely upwards and are several inches in length, forming turbinate clumps 12 inches broad and high. Branches $\frac{1}{2}$ to $\frac{3}{4}$ in. thick; the smaller branches 1 to 2 in. long, nearly $\frac{1}{4}$ in. diameter, and often very prolific at the summits. The marginal branchlets are as regular as those of the middle, and the corallites are not more spreading. (*Dana*.)

Verrill states that this form is quite distinct from *M. surculosa*, and proposed to give it the rank of a species. Until the type specimens have been compared and the differences noted, I think it undesirable to change the arrangement proposed by Dana.

Tahiti.

Var. *diffusa*, Dana, Zoophytes, p. 446.

Branchlets proliferous above and similar in size and form (? to those of the type), but the branches are $\frac{1}{2}$ to $\frac{3}{4}$ in. thick, distantly coalescent, with very large spaces; the branchlets are more remote, often 1 in. apart. The type specimen is in the possession of the Boston Society of Natural History, and consists approximately of one-fourth of the whole colony; it is 18 in. long and 15 in. broad. (*Dana.*)

Dana remarks that this variety has more the habit of *M. subulata* than of *M. surculosa*, but that it differs from that species in the length and character of its branchlets.



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[The figures in bold type refer to the pages on which the descriptions will be found; the remainder to synonyms.]

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The figures show to the best advantage when examined by means of a reading-lens of 3 or 4 in. diameter. The usual small pocket-lens is not suitable for this purpose.

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Fig. E. *Madrepora cophodactyla* (p. 148).

PLATE XXIV.

Madrepora brueggemanni (p. 145). Singapore. $\frac{2}{3}$ nat. size.

PLATE XXV.

Figures about $\frac{1}{2}$ nat. size.

Fig. A. *Madrepora studeri*, upper surface (p. 126).

Fig. B. *Madrepora studeri*, under surface (p. 126).

PLATE XXVI.

Figures about $\frac{1}{2}$ nat. size.

Fig. A. *Madrepora vaxiformis*, upper surface (p. 37). Rodriguez.

Fig. B. *Madrepora smithi* (p. 34).

PLATE XXVII.

Figures about $\frac{1}{2}$ nat. size.

Fig. A. *Madrepora brevicollis* (p. 159). Thursday Island, Torres Straits.

Fig. B. *Madrepora brevicollis*, var. *pustulifera* (p. 160). Rodriguez.

Fig. C. *Madrepora nigra* (p. 45). Tizard Bank.

Fig. D. *Madrepora pectinata*, under surface (p. 95). Thursday Island, Torres Straits.

Fig. E. *Madrepora pectinata*, upper surface (p. 95). Thursday Island, Torres Straits.

Fig. F. *Madrepora recumbens* (p. 106). Rocky Island, Great-Barrier Reef.

PLATE XXVIII.

Figures about $\frac{1}{2}$ nat. size.

Fig. A. *Madrepora pulchra* (p. 44). Keeling Island.

Fig. B. *Madrepora pulchra*, var. *stricta* (p. 44). Tizard Bank.

Fig. C. *Madrepora pulchra*, var. *alveolata* (p. 44). Palm Island, Great-Barrier Reef.

Fig. D. *Madrepora delicatula*, side view of a branch (p. 109). Treasury Island, Solomon Islands.

Fig. E. *Madrepora delicatula* (p. 109). Port Denison.

Fig. F. *Madrepora affinis* (p. 60). Darnley Island, Torres Straits.

PLATE XXIX.

Figures about $\frac{2}{5}$ nat. size.

Fig. A. *Madrepora inermis*, under surface (p. 194). South Seas.

Fig. B. *Madrepora inermis*, upper surface (p. 194). South Seas.

Fig. C. *Madrepora subglabra* (p. 186). South Seas.

Fig. D. *Madrepora procumbens* (p. 188). South Seas.

Fig. E. *Madrepora tenella* (p. 193). Macclesfield Bank, China Sea.

Fig. F. *Madrepora rambleri* (p. 189). Macclesfield Bank, China Sea.

PLATE XXX.

Figures about $\frac{2}{5}$ nat. size.

Fig. A. *Madrepora bifaria* (p. 110).

Fig. B. *Madrepora pacifica* (p. 39). Samoa.

Fig. C. *Madrepora listeri*, var. *conica* (p. 52). Tongatabu.

Fig. D. *Madrepora listeri* (p. 52). Tongatabu.

PLATE XXXI.

Figures a little more than $\frac{1}{3}$ nat. size.

Fig. A. *Madrepora samoensis*, side view of a branch (p. 143). Samoa.

Fig. B. }
Fig. C. } *Madrepora polymorpha* (p. 169). Malacca.
Fig. D. }

PLATE XXXII.

Figures about $\frac{2}{5}$ nat. size.

Fig. A. *Madrepora obscura* (p. 129). Ceylon.

Fig. B. *Madrepora spathulata* (p. 121). Treasury Island, Solomon Islands.

Fig. C. *Madrepora cancellata* (p. 166). Louisiade Archipelago.

Fig. D. *Madrepora quelchi*, var. *paradoxa* (p. 90). Solomon Islands.

Fig. E. *Madrepora quelchi* (p. 90). Amboina.

PLATE XXXIII.

Figures about $\frac{1}{2}$ nat. size.

Fig. A. *Madrepora dendrum*, var. (p. 81). Macclesfield Bank, China Sea.

Fig. B. *Madrepora dendrum* (type) (p. 81). Macclesfield Bank, China Sea.

- Fig. C. *Madrepora sinensis* (p. 114). Formosa.
 Fig. D. *Madrepora disticha* (p. 84). Diego Garcia.
 Fig. E. *Madrepora syringodes* (p. 177). Palm Island, Great-Barrier Reef.
 Fig. F. *Madrepora compressa* (p. 60). Tizard Bank.

PLATE XXXIV.

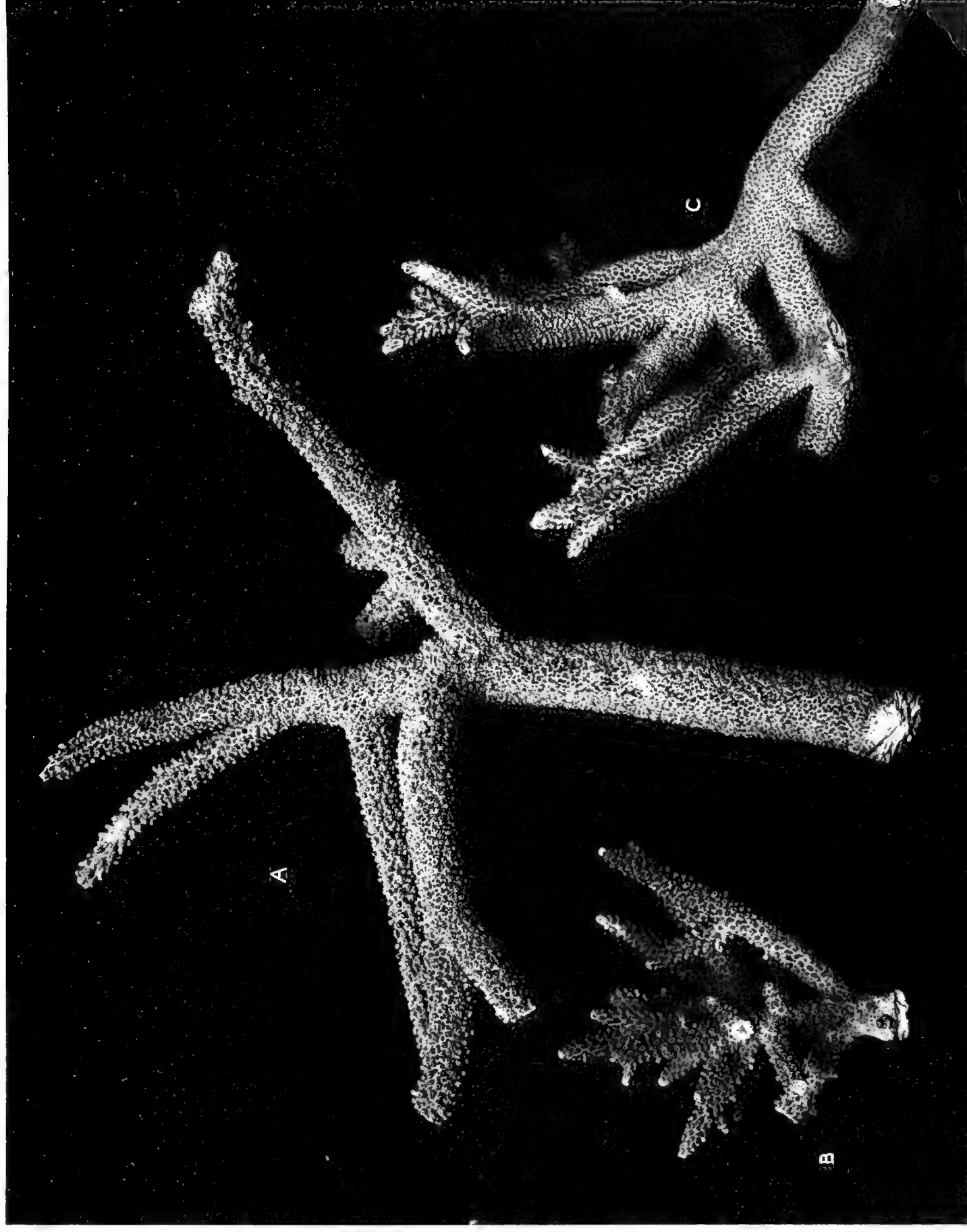
Figures about $\frac{1}{2}$ nat. size.

- Fig. A. *Madrepora indica* (p. 113). Ramesvaram.
 Fig. B. *Madrepora pruinosa* (p. 72). Korea Straits?
 Fig. C. *Madrepora botryodes* (p. 153). Rodriguez.
 Fig. D. *Madrepora glauca* (p. 164). West Australia.
 Fig. E. *Madrepora frondosa* (p. 114).

PLATE XXXV.

Figures about $\frac{2}{3}$ nat. size.

- Fig. A. *Madrepora thurstoni*, a single branch (p. 200). Ceylon.
 Fig. B. *Madrepora africana* (p. 83). ? S.E. coast of Africa.
 Fig. C. } *Madrepora attenuata* (p. 33). West Indies.
 Fig. D. }
 Fig. E. *Madrepora brueggemanni*, var. *uncinata* (p. 145). Singapore.

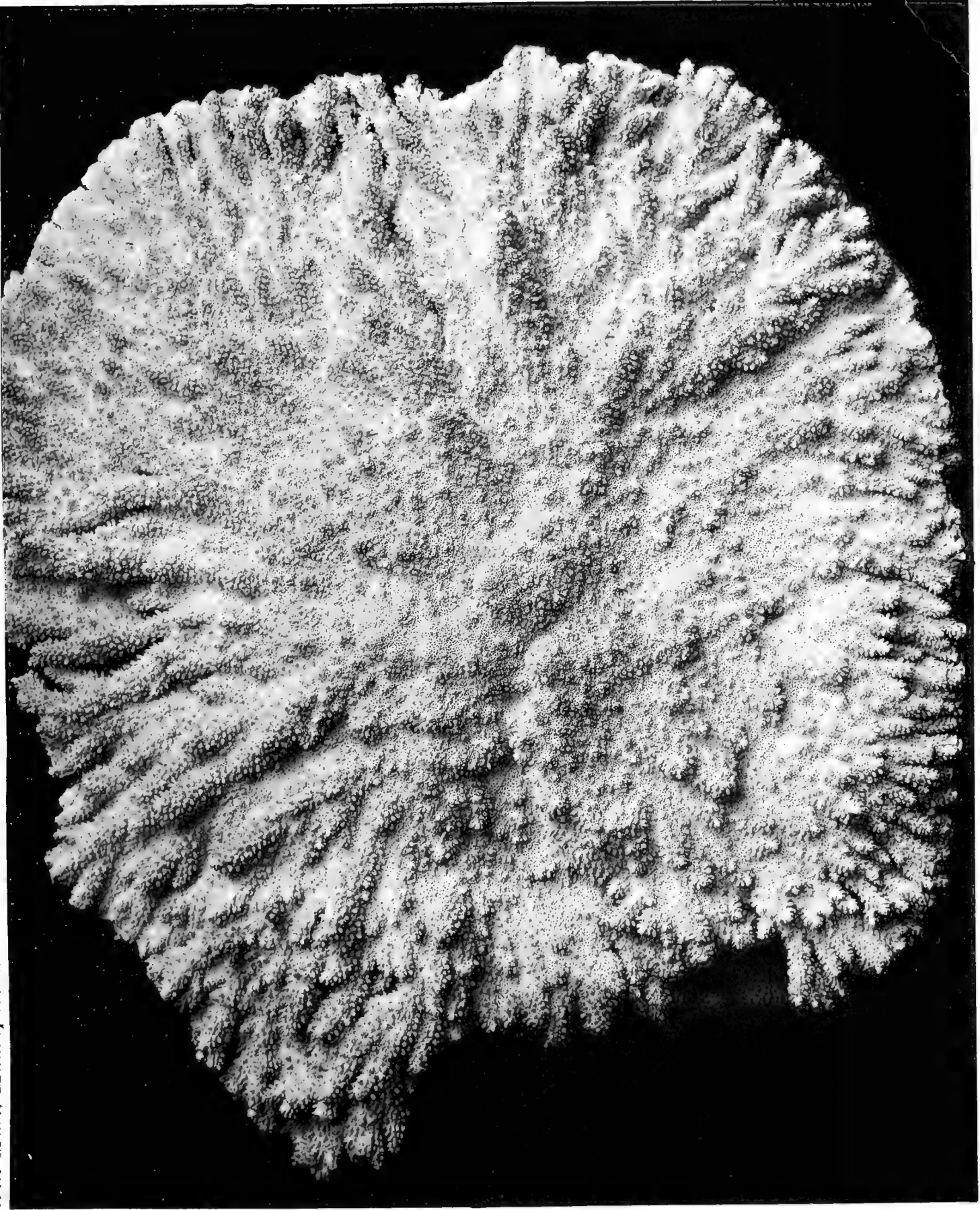


A. *Madrepora grandis*,

B. *M. grandis*, var.

C. *Madrepora intermedia*.

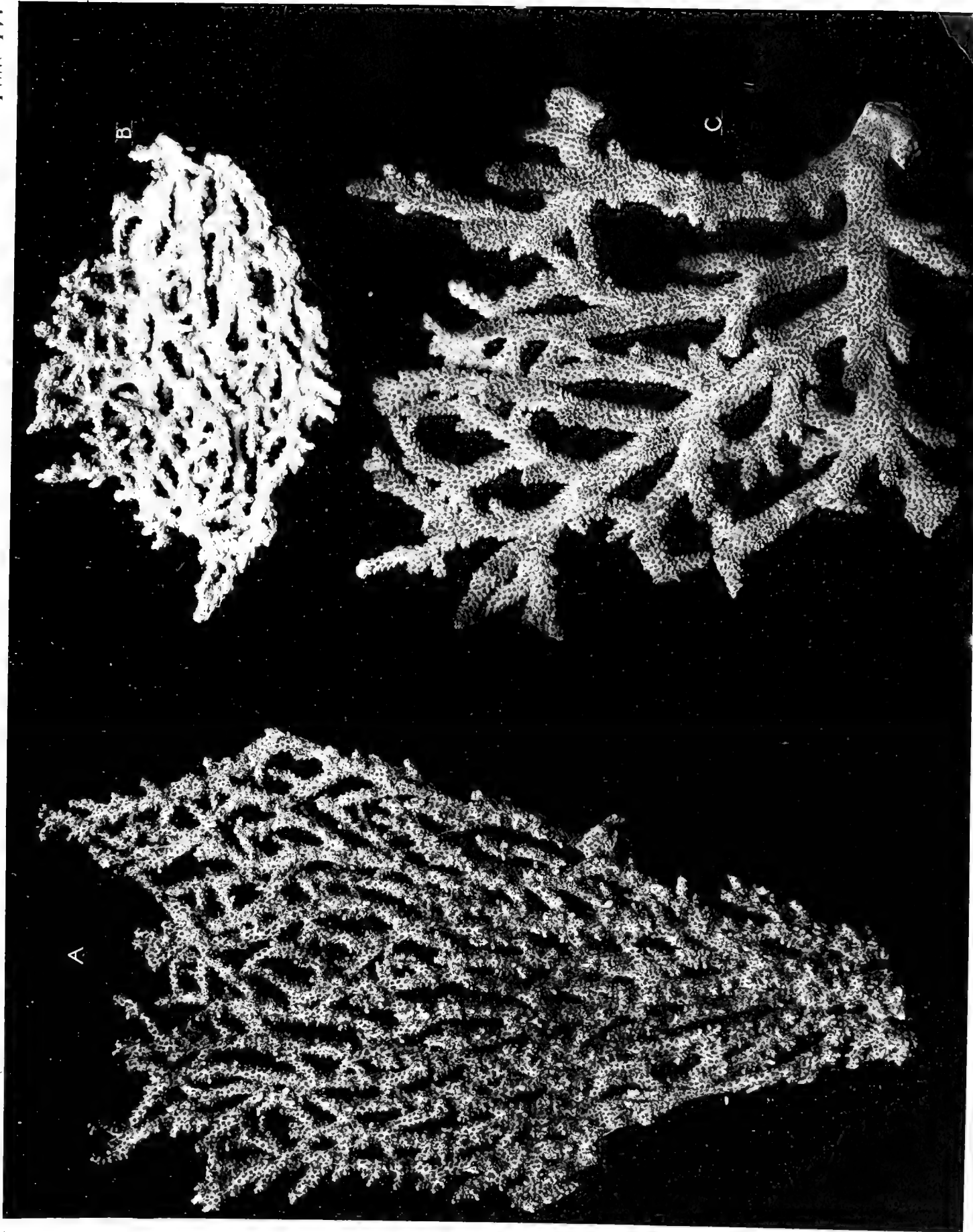




Madrepora orbicularis.

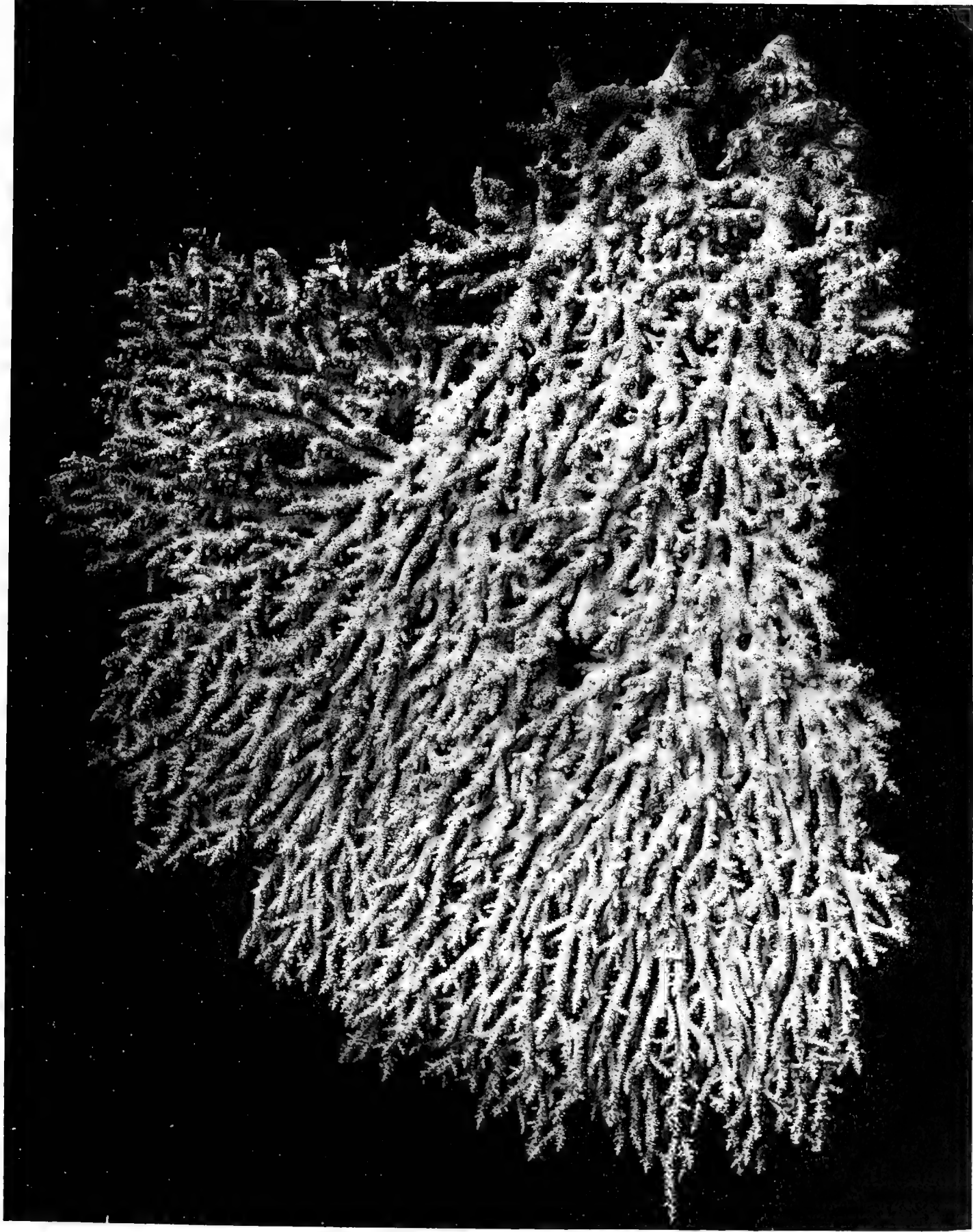






A. *Madrepora reticulata* (upper surface). B. The same (lower surface).
C. *Madrepora complanata*.



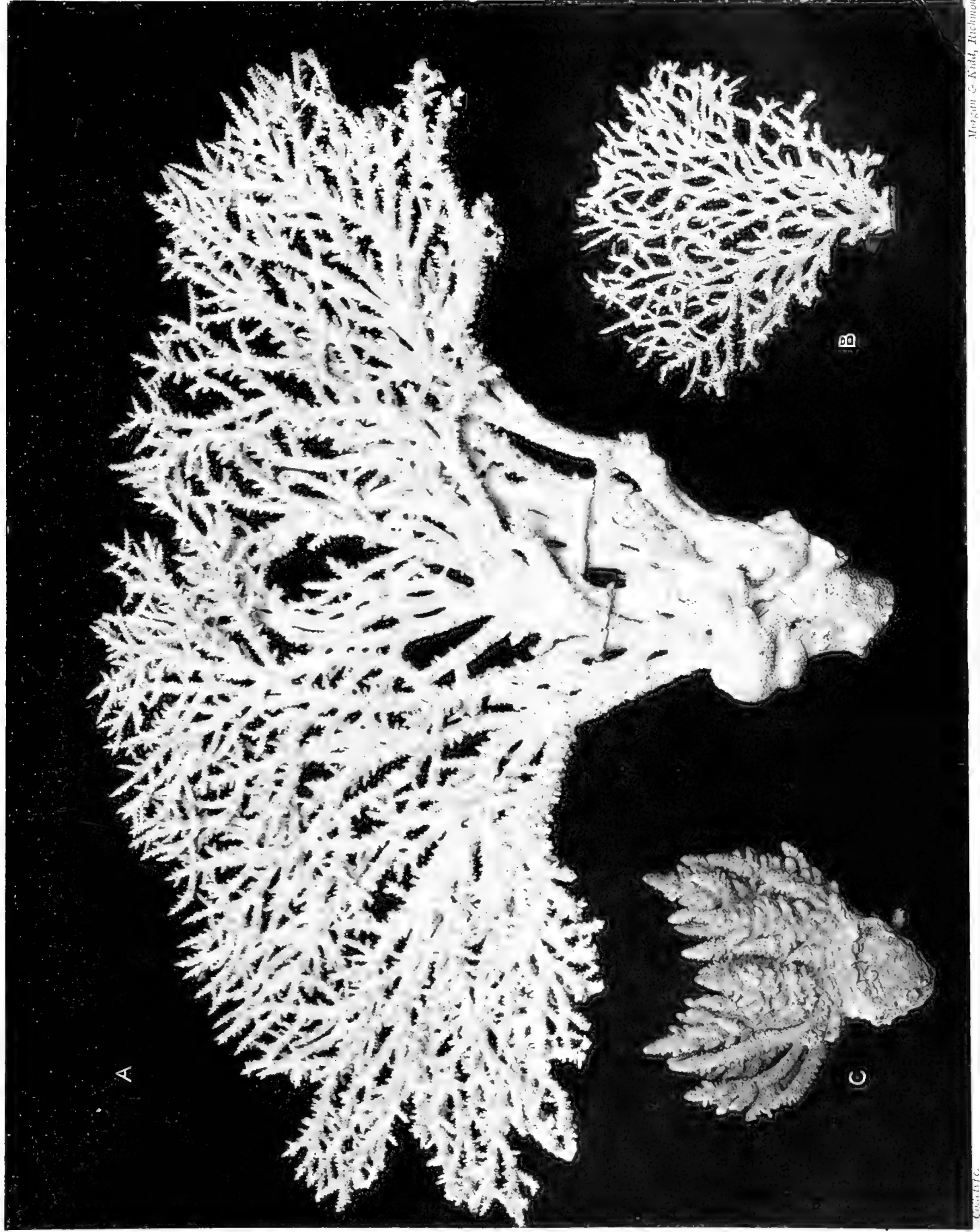


Colotype

Morgan & Kall, Richmond.

Madrepora clathrata.





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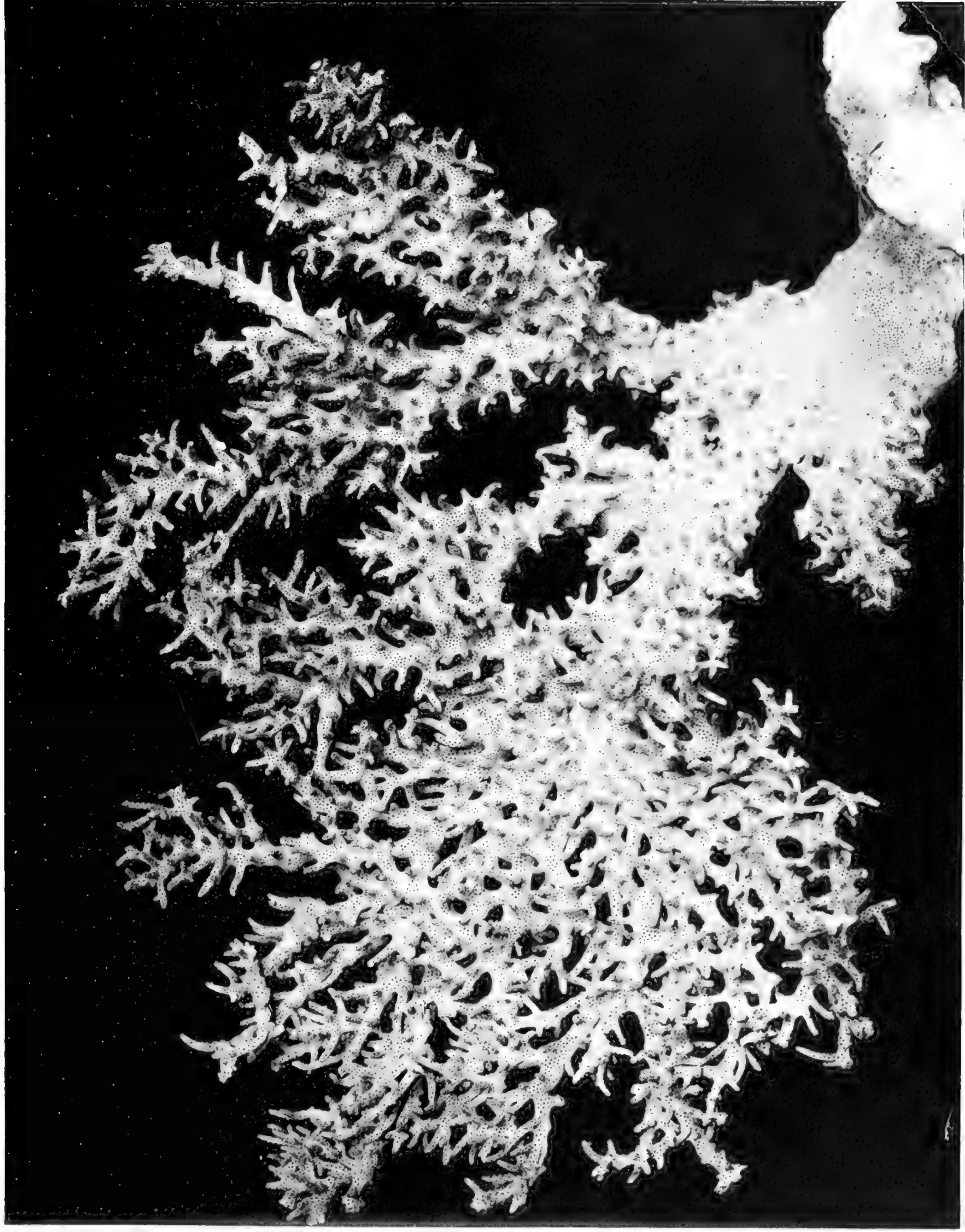
Morgan & Kidd, Richmond, L.

A. *Madrepora clathrata*.

B. The same, young colony.

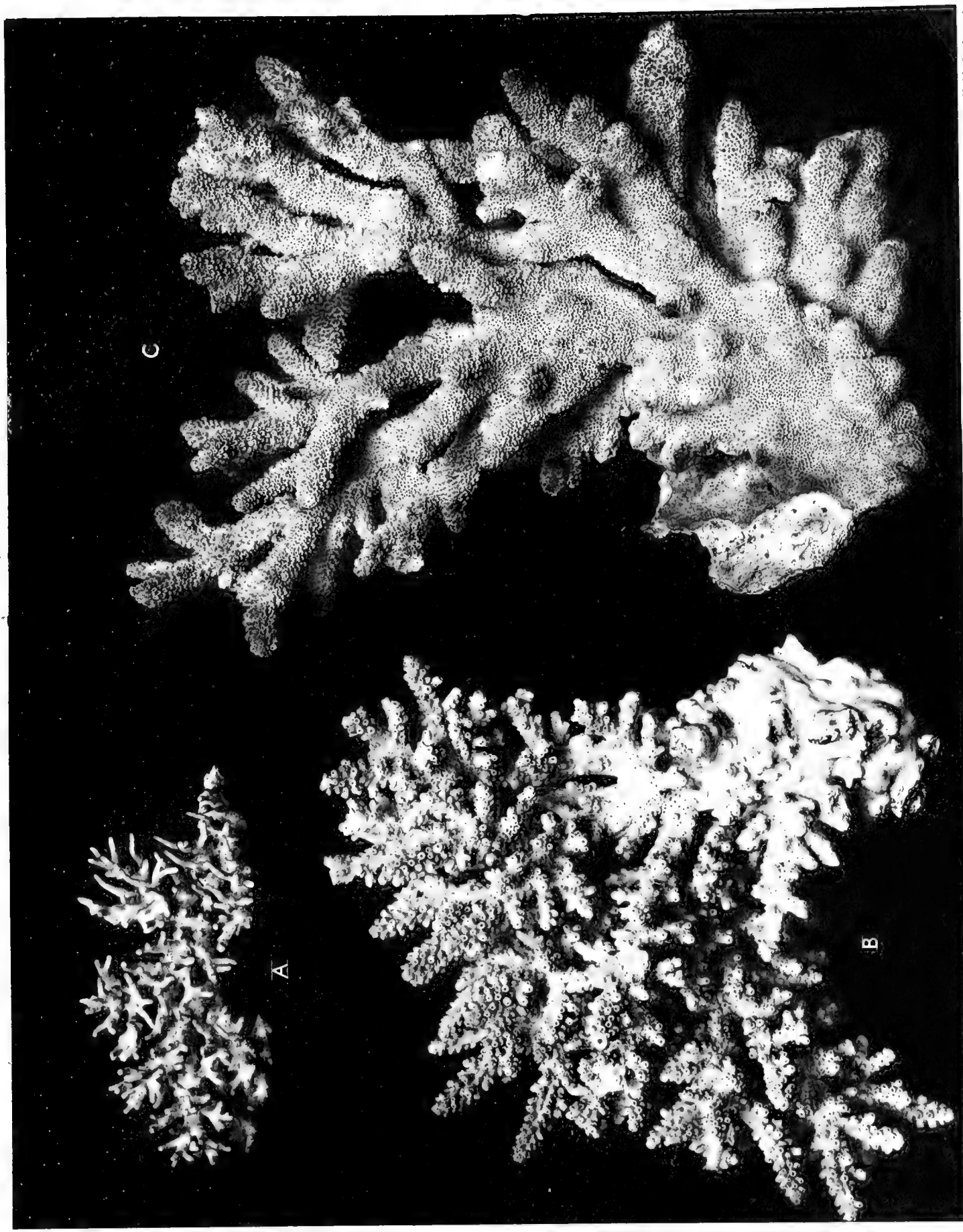
C. *Madrepora samoensis*.





Madrepora oligocyathus.





Collotype

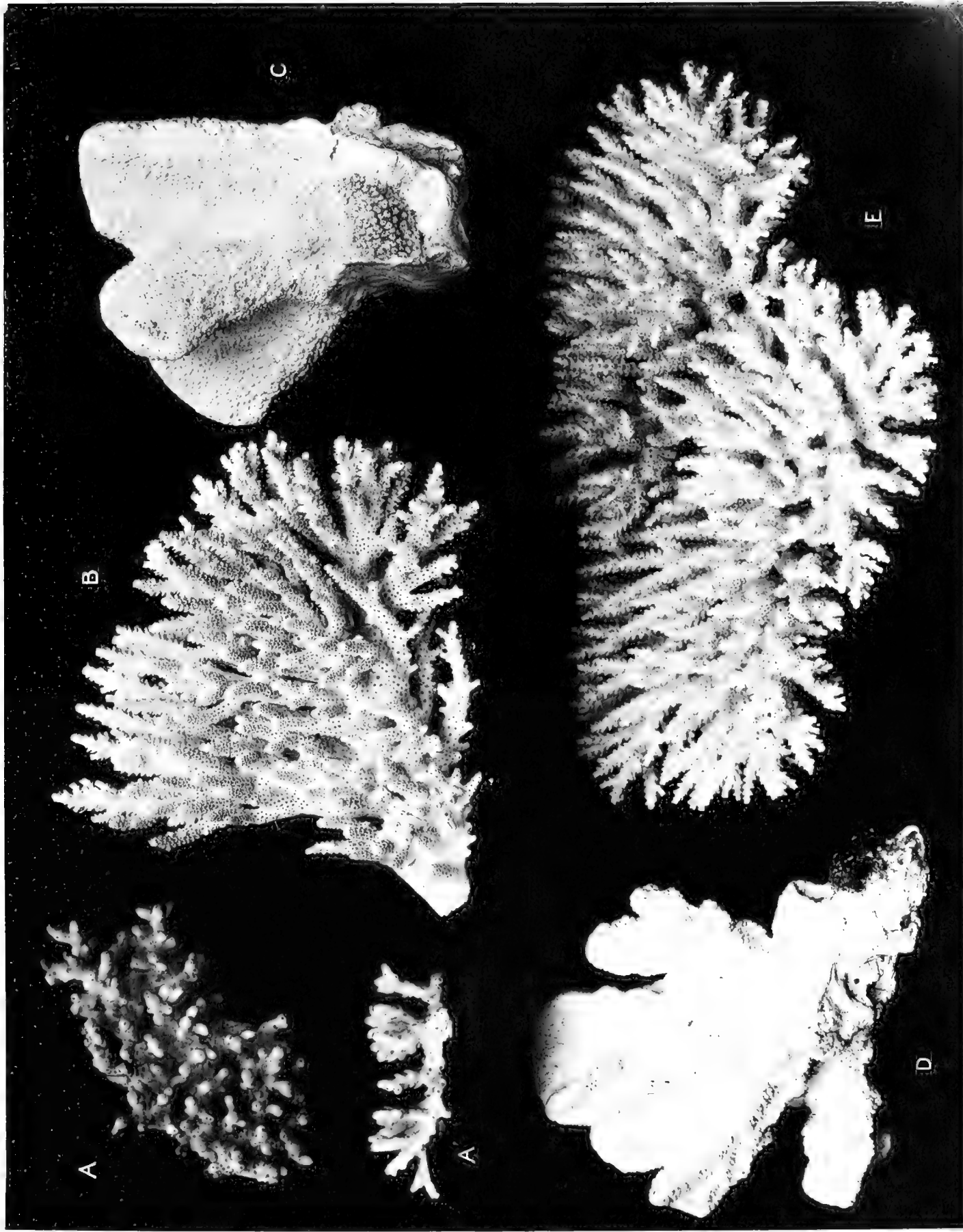
Morgan & Kidd, Richmond.

A. *Madrepora rayneri*.

B. *Madrepora loripes*.

C. *Madrepora ambigua*.



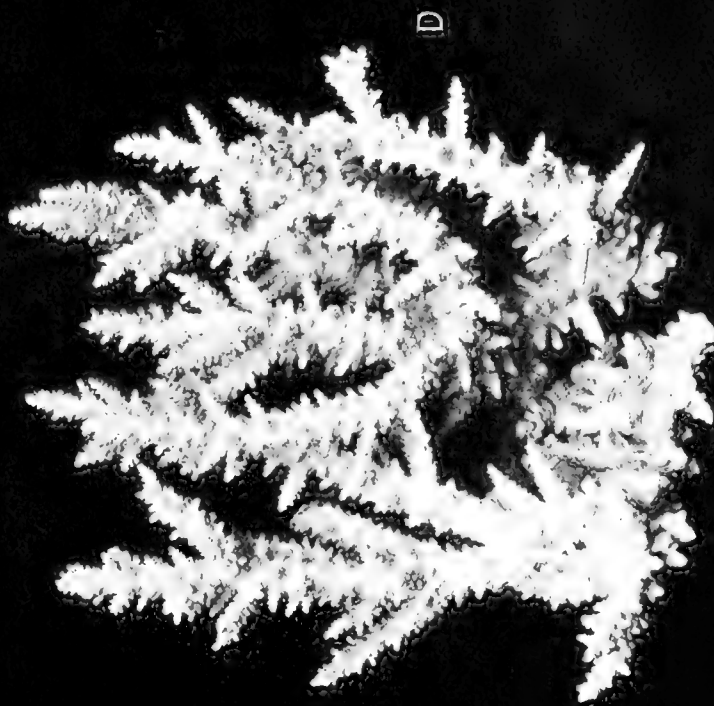
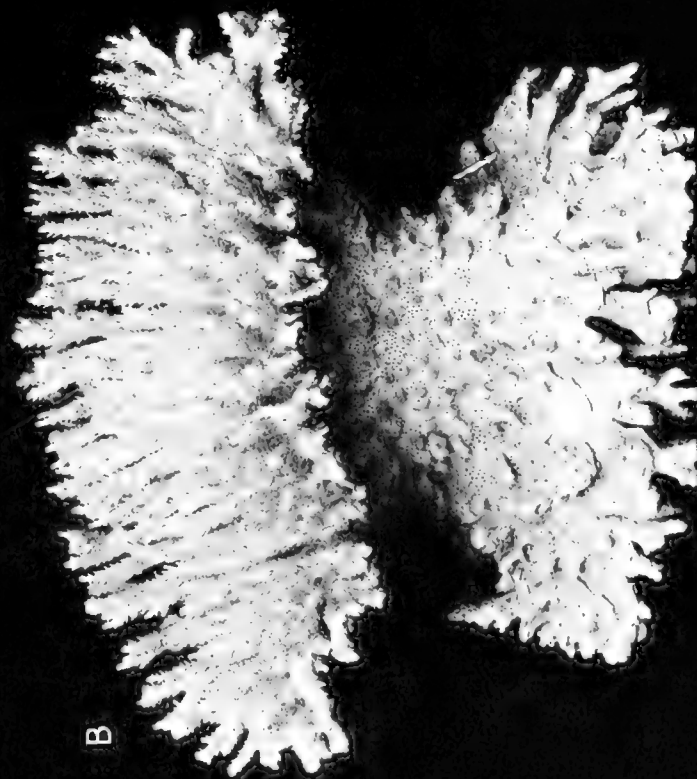
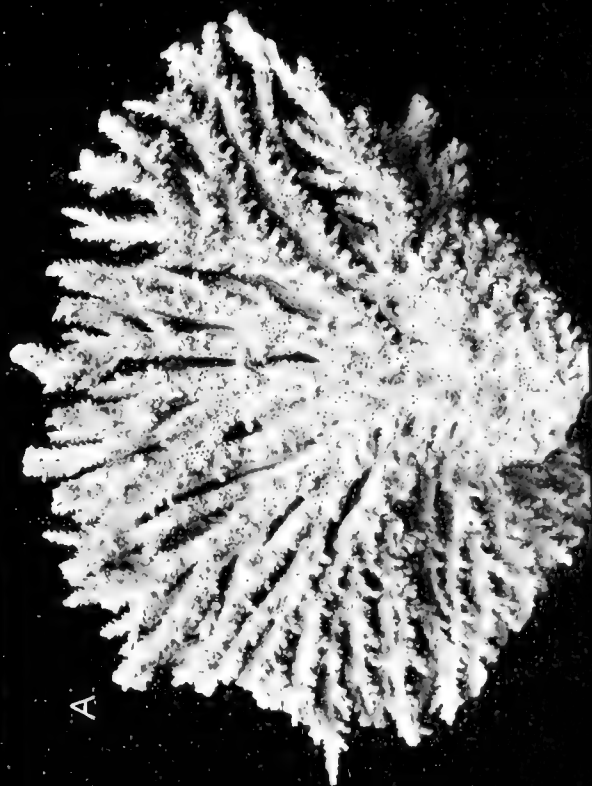


Collected by

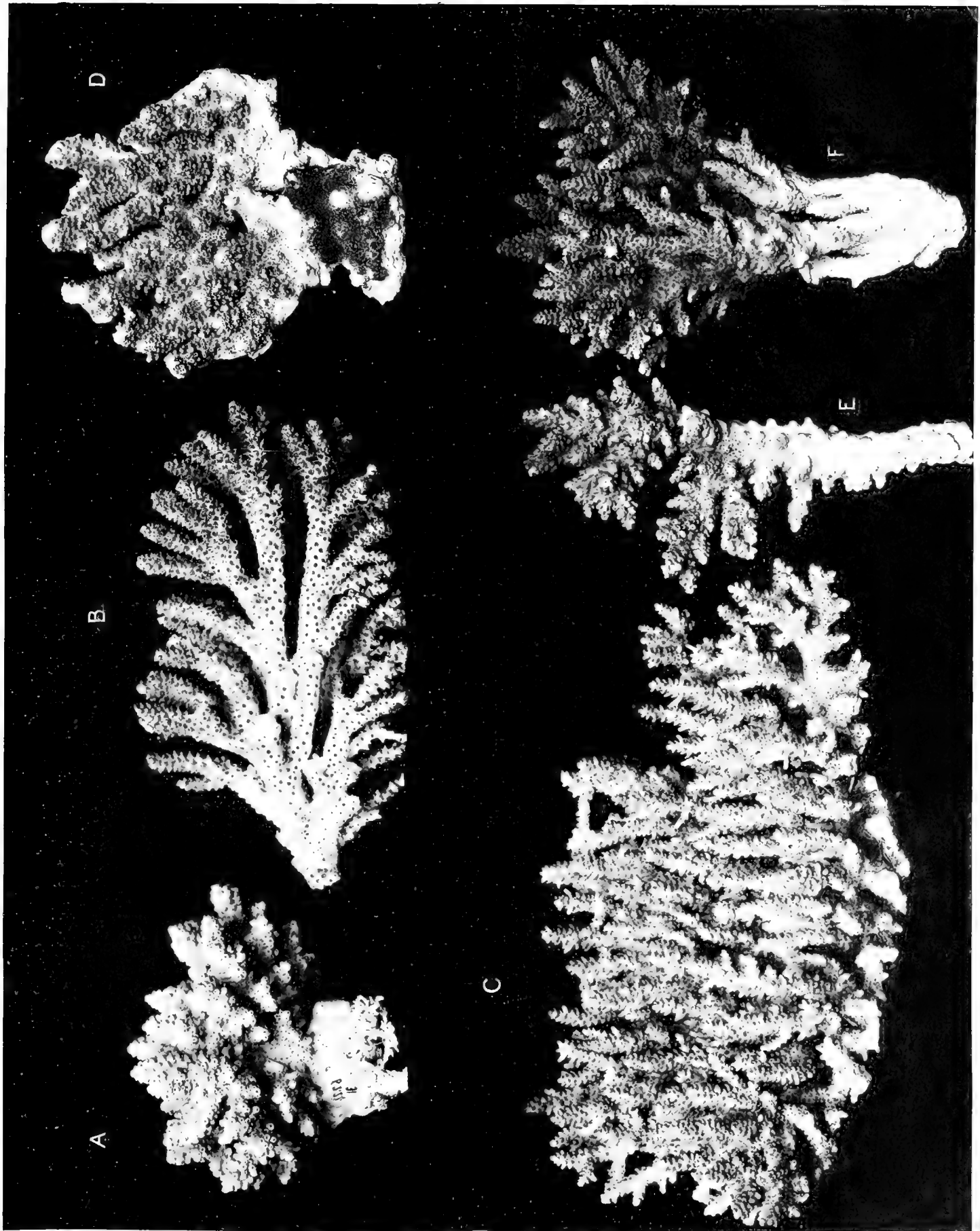
Morgan & Kidd, Richmond.

A, A'. *Madrepora clavigera*. B. *Madrepora latistella*. C. *Madrepora hispida*.
D. *Madrepora plicata*. E. *Madrepora patula*.









Collected by

W. S. K. L. H. H. H.

A. *Madrepora violacea*. B. *Madrepora kenti*.
C. *Madrepora tizardi*. D. *M. tizardi*, var. E, F. *Madrepora elseyi*.



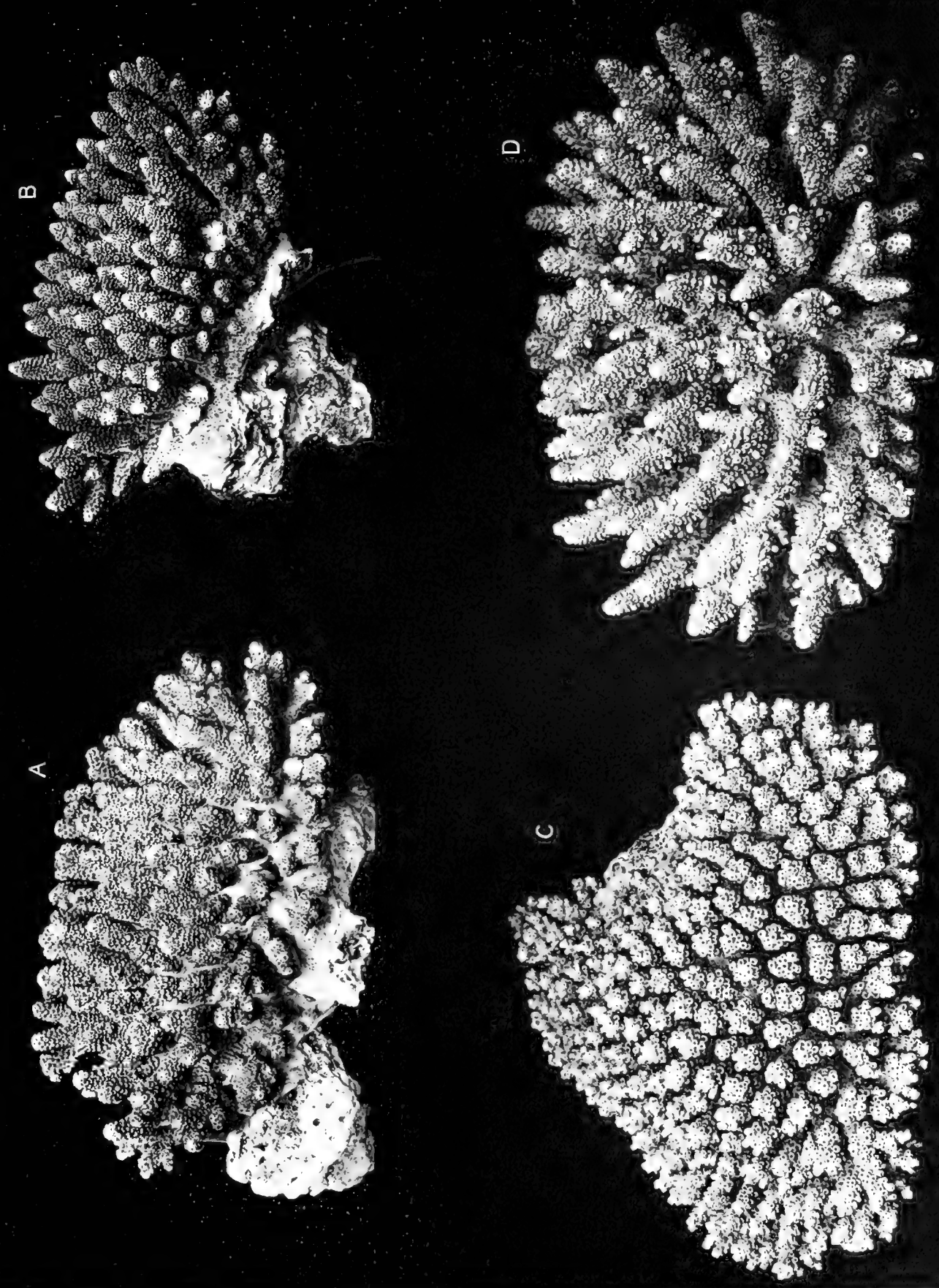


C. J. 10070

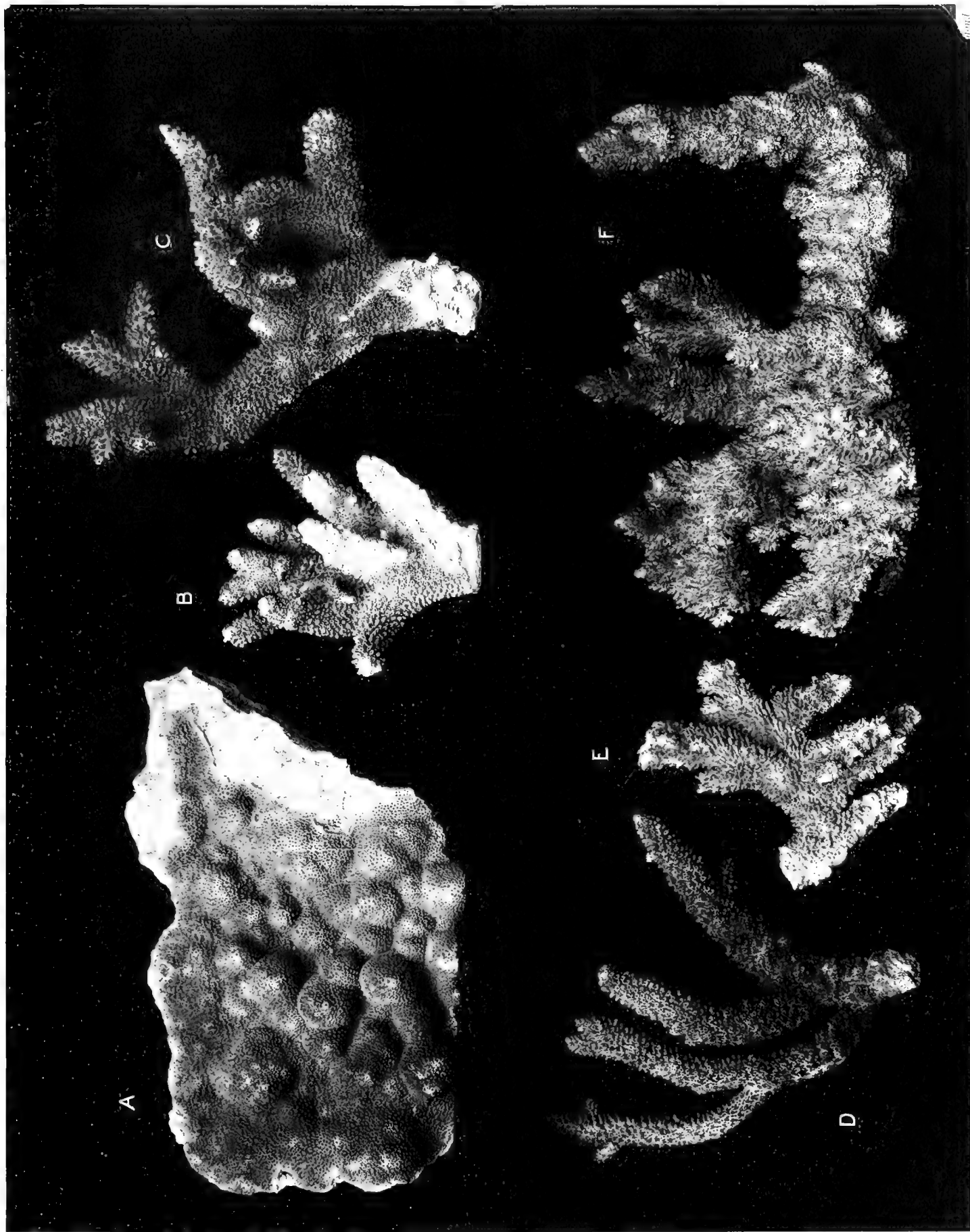
Morgan & Kidd, Reunion

Madrepora arcuata.





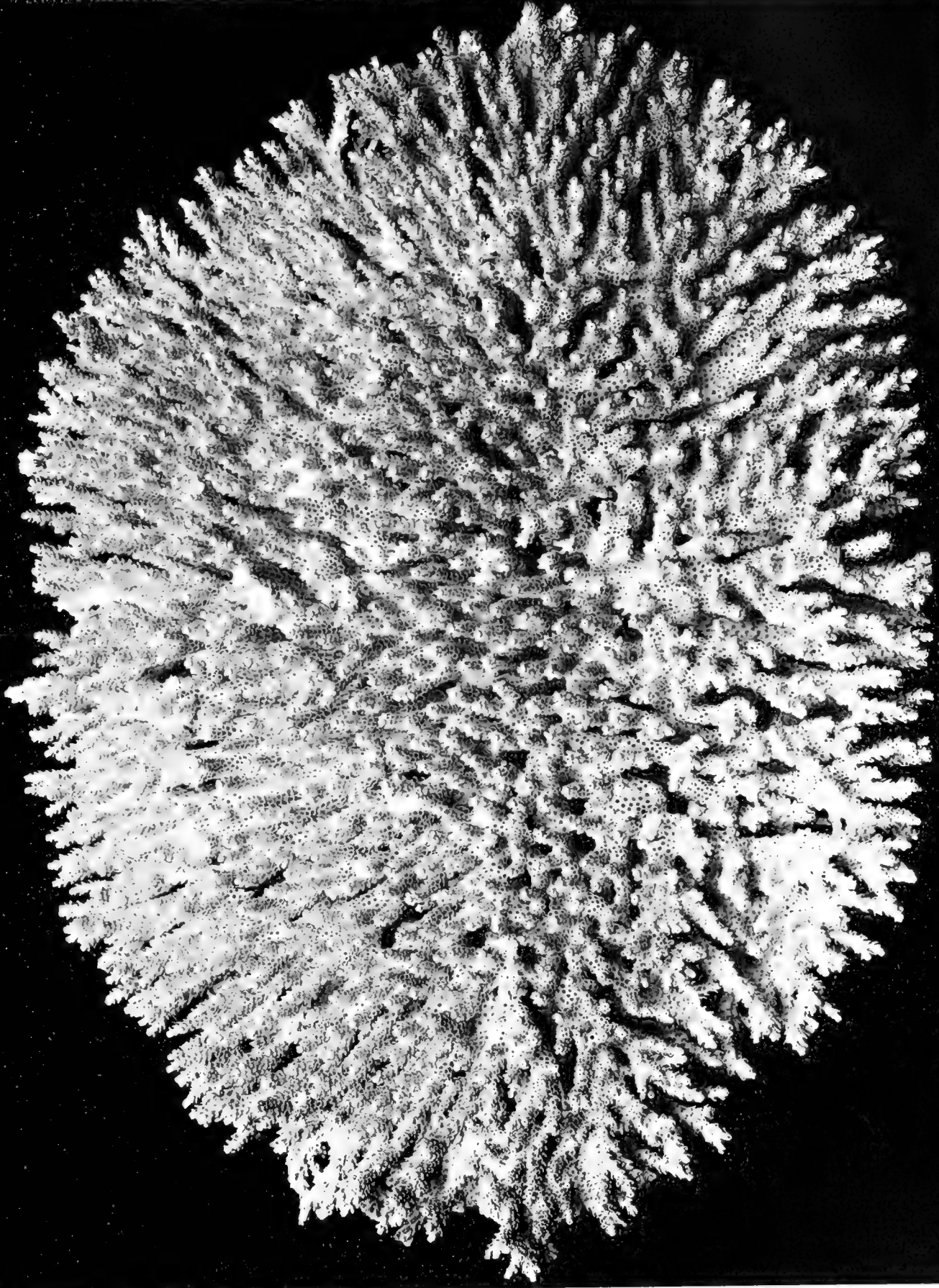
A. *Madrepora baodactyla* (variety). B. *Madrepora baodactyla*.
C. *Madrepora anthocercis*. D. *Madrepora bullata*.

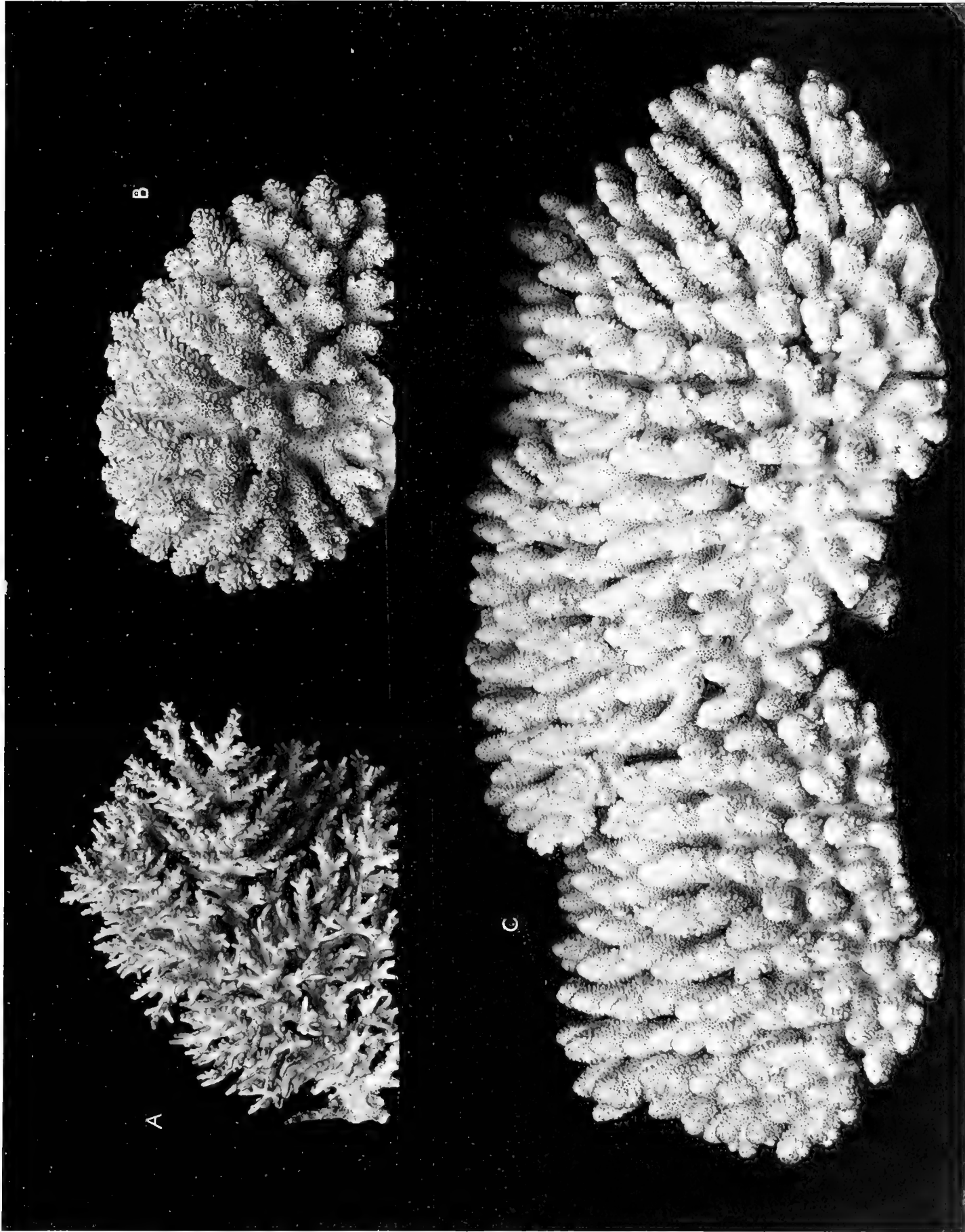


A. *Madrepora monticulosa*. B, C. *Madrepora decipiens*, forma a.
D. *Madrepora decipiens*, forma b. E, F. *Madrepora irregularis*.

Morgan & Kidd, R.

coll. type



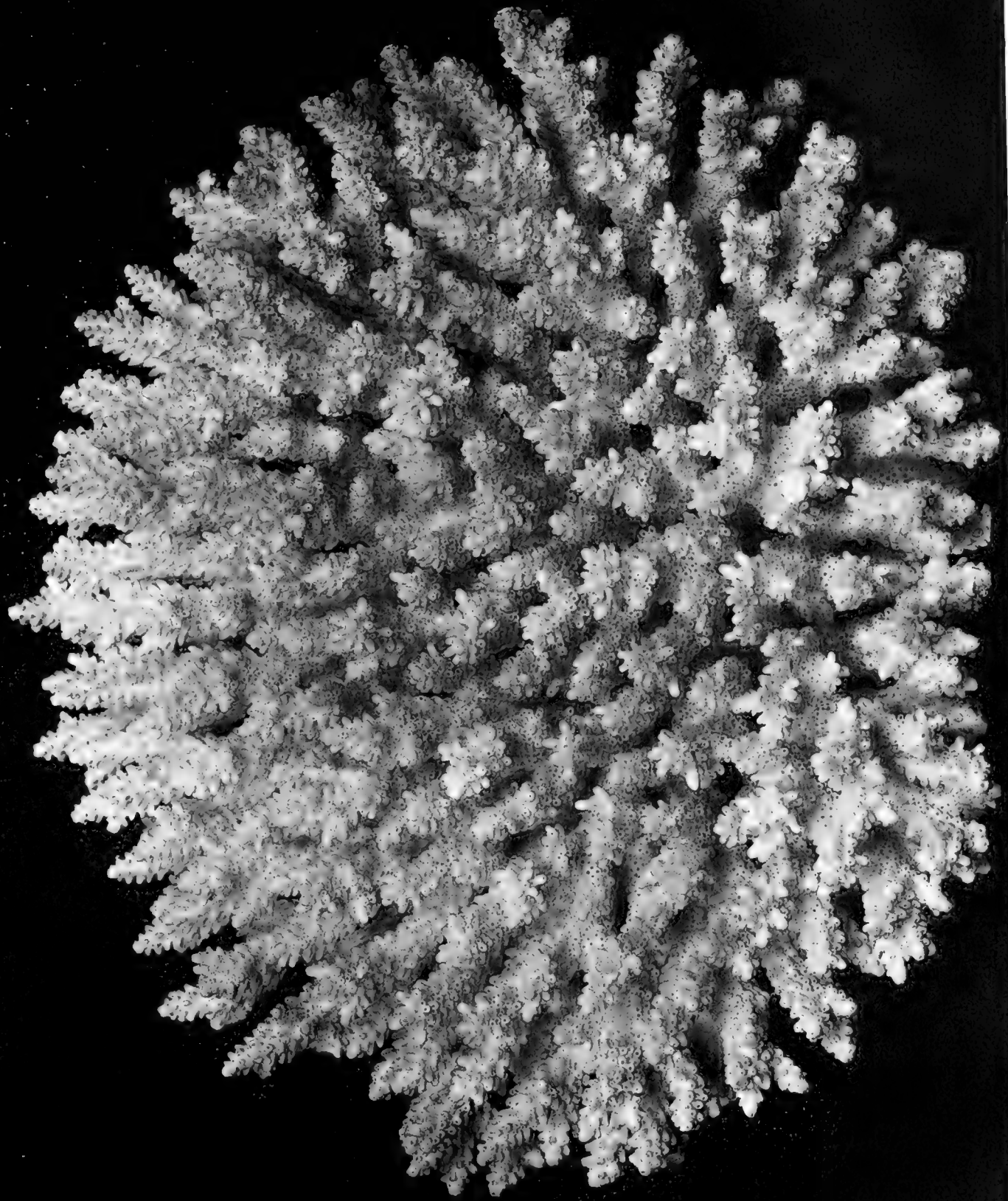


A. *Madrepora rosaria* var. *dumosa*. B. *Madrepora diversa*.
C. *Madrepora leptocylathus*.

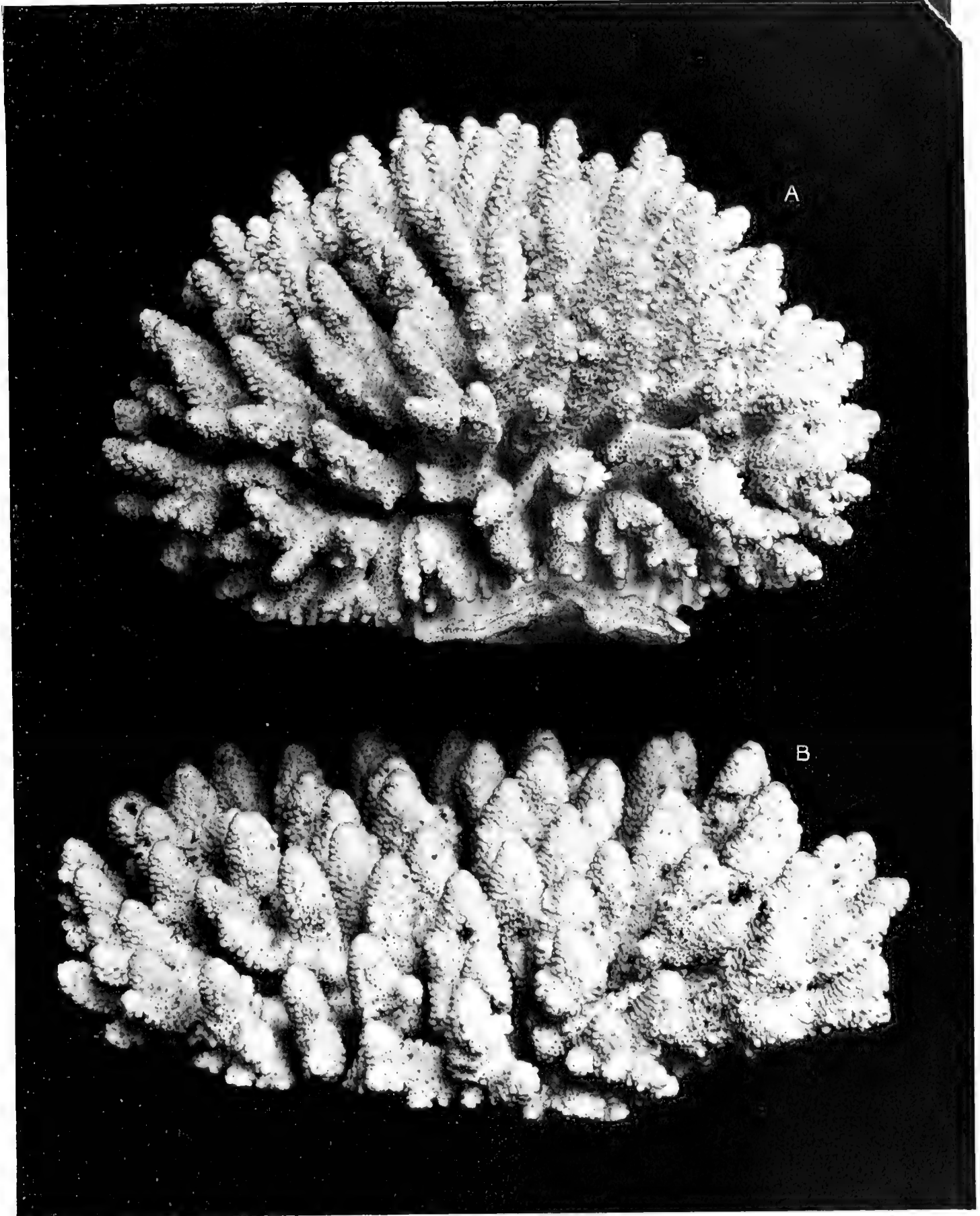
W. & A. G. Reade, London

Gr. 10/11









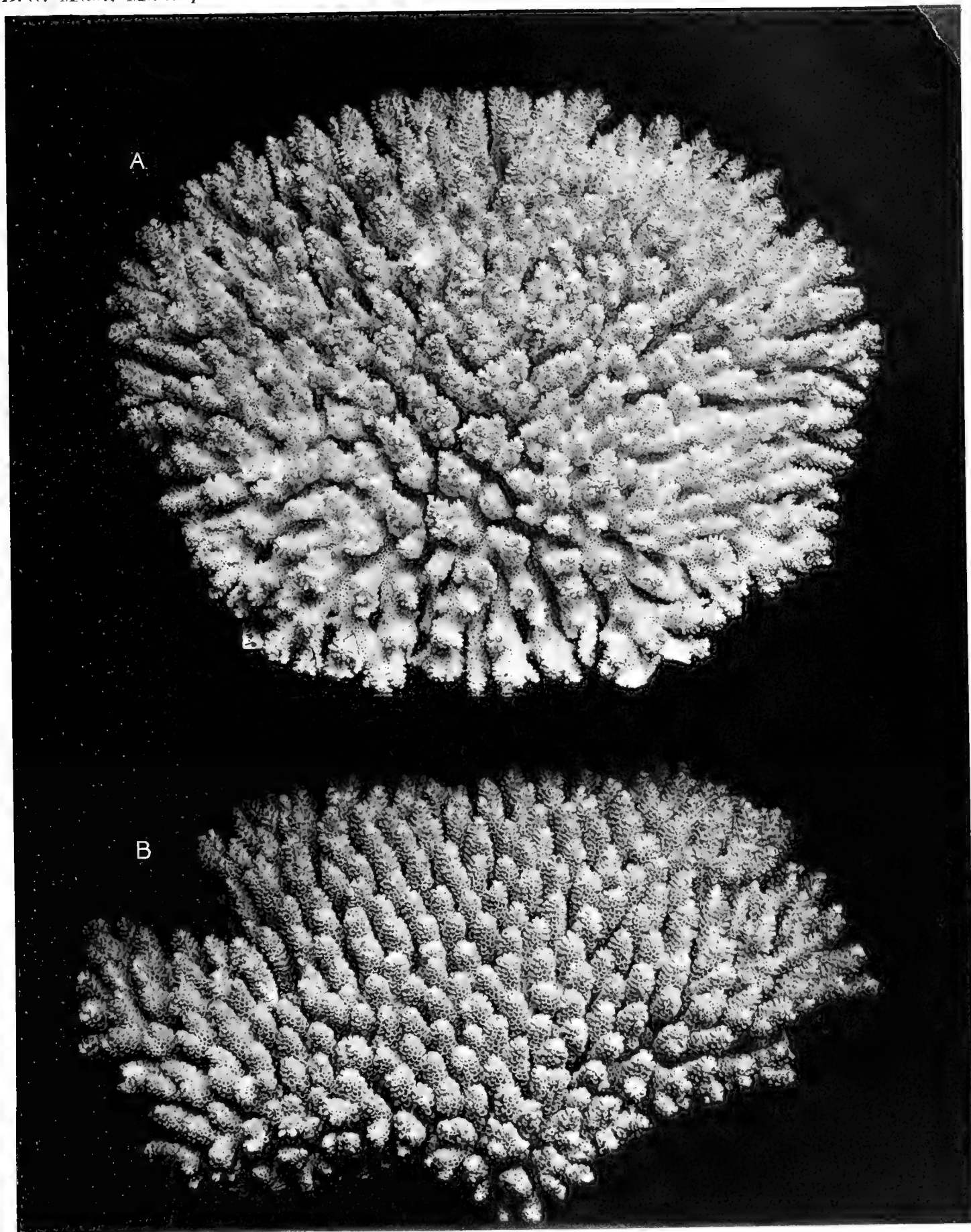
Castellani

Alcock & Reed

A. *Madrepora fruticosa*.

B. *Madrepora spectabilis*.



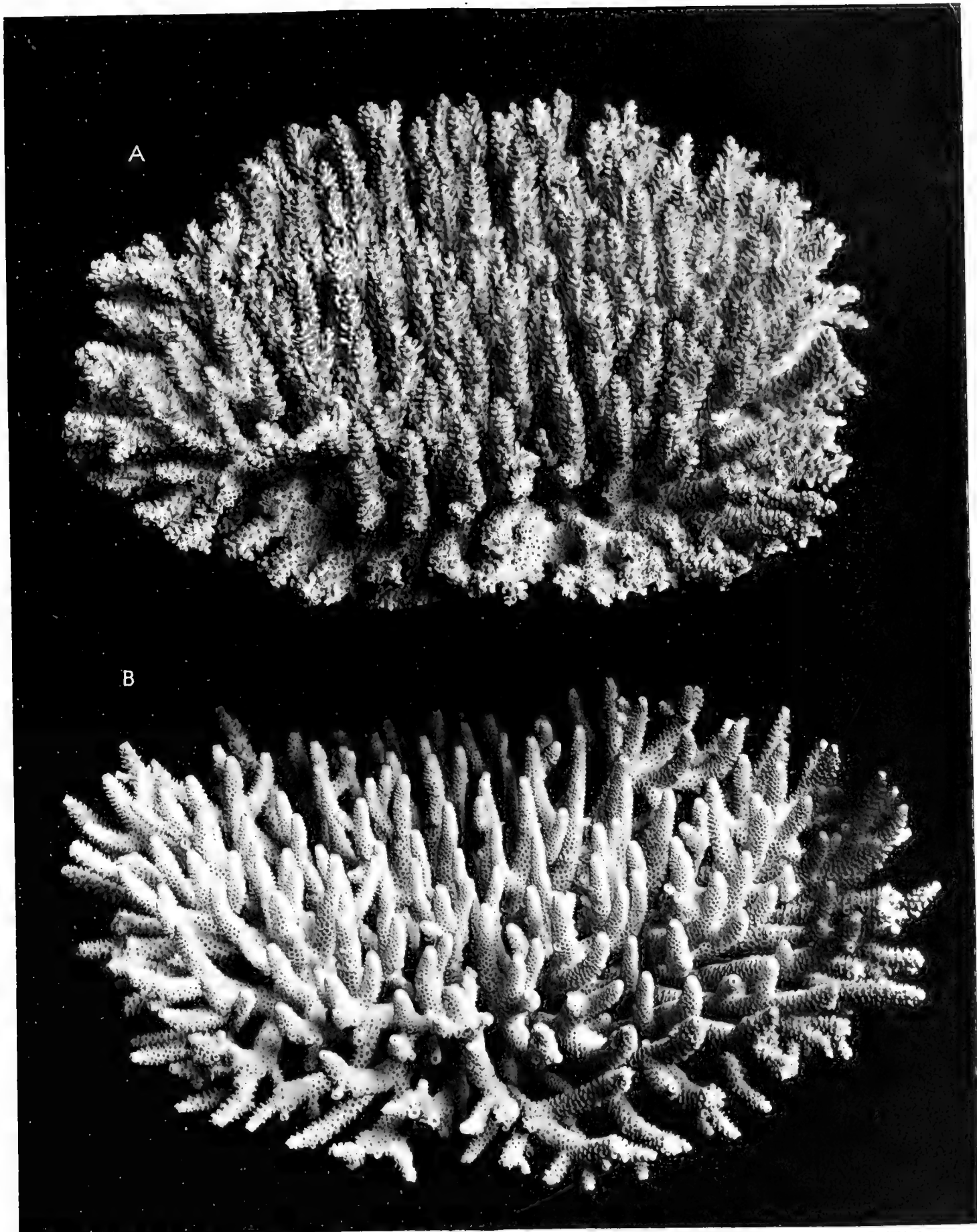


Collotype.

Morgan & Kidd, Richmond.

A. *Madrepora polystoma*.

B. *Madrepora macrostoma*.



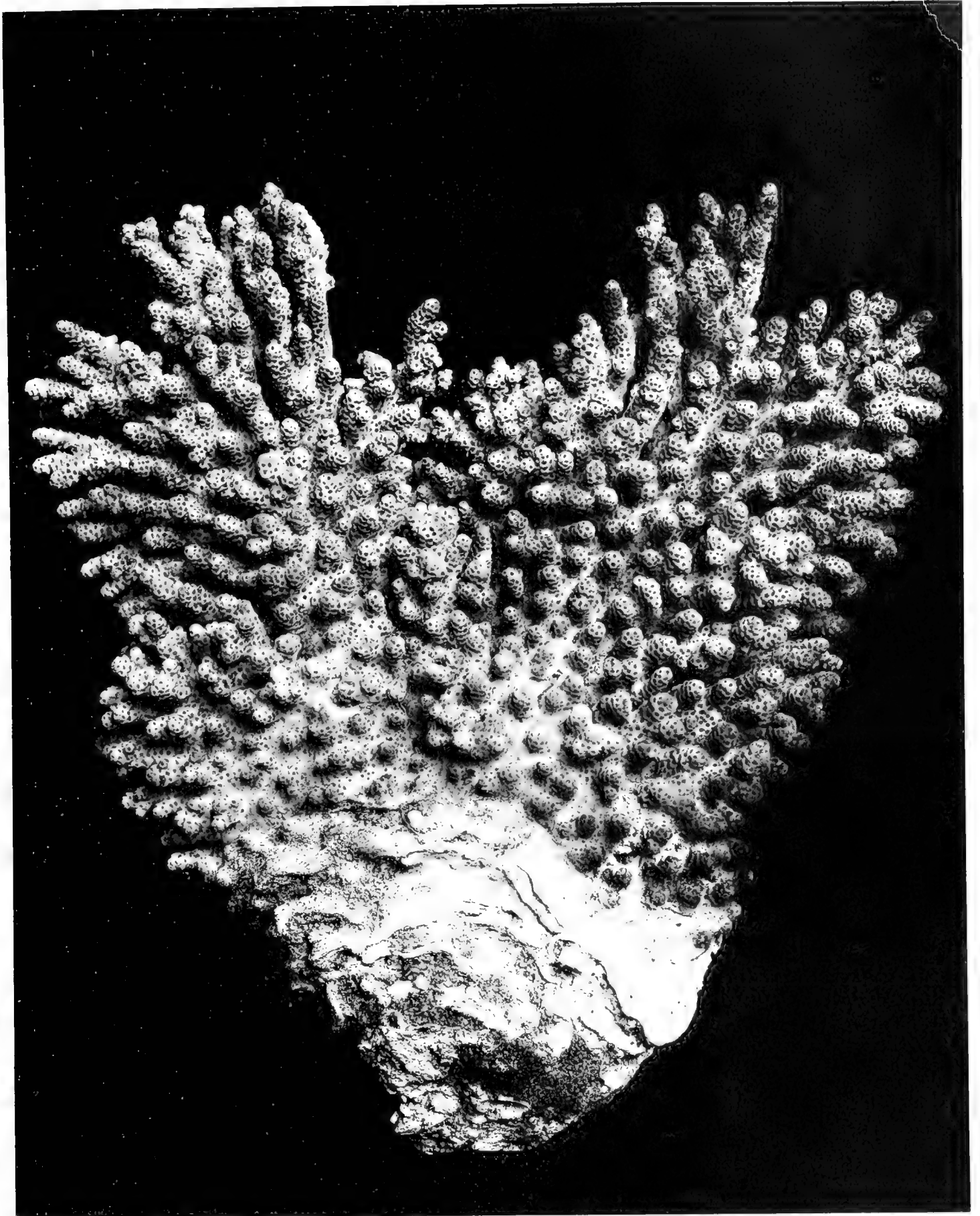
Collotype.

Morgan & Kild, Richmond.

A. Madrepora assimilis.

B. Madrepora squamosa.

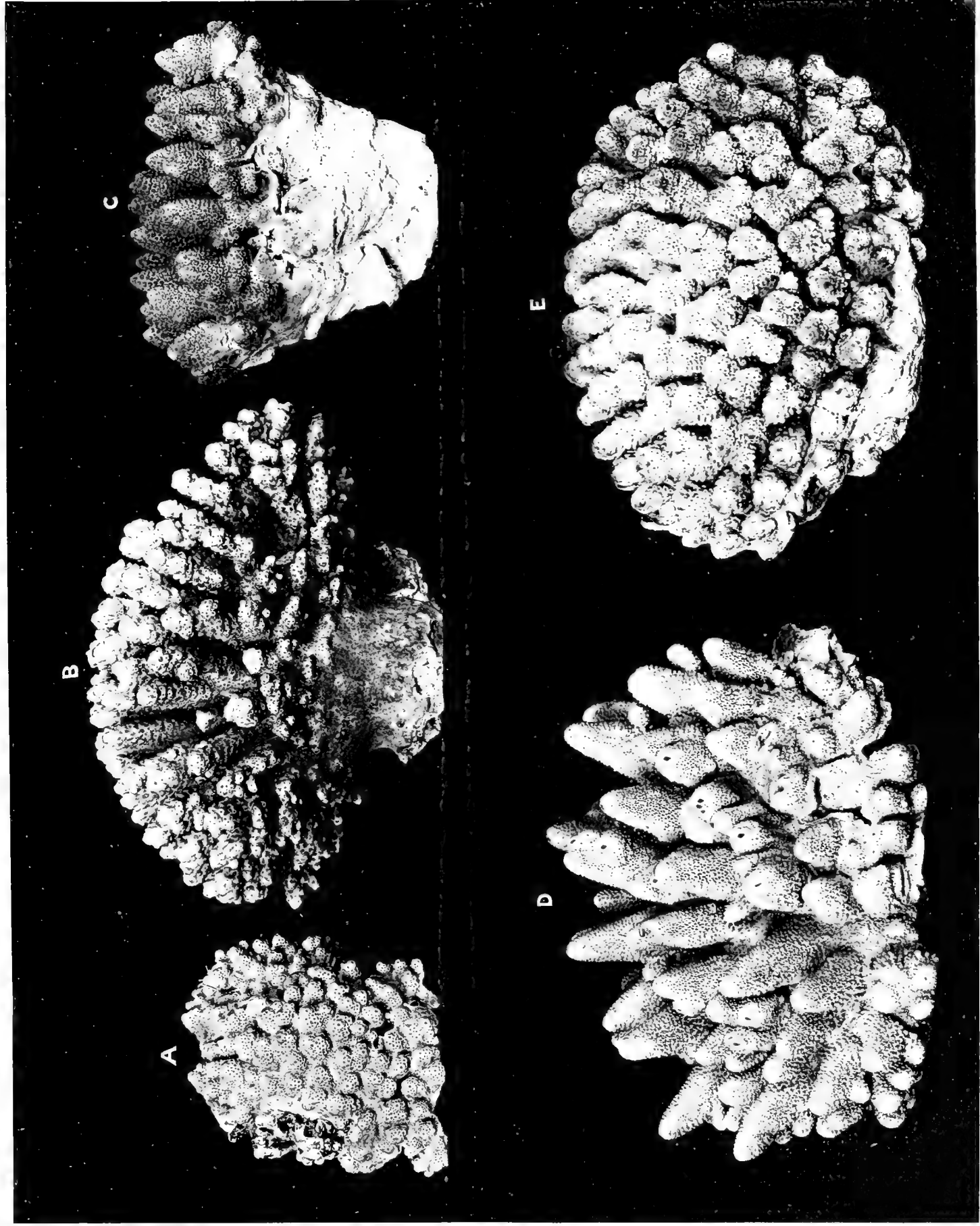




Collotype.

Morgan & Kidd, Richmond.

Madrepora sarmentosa.

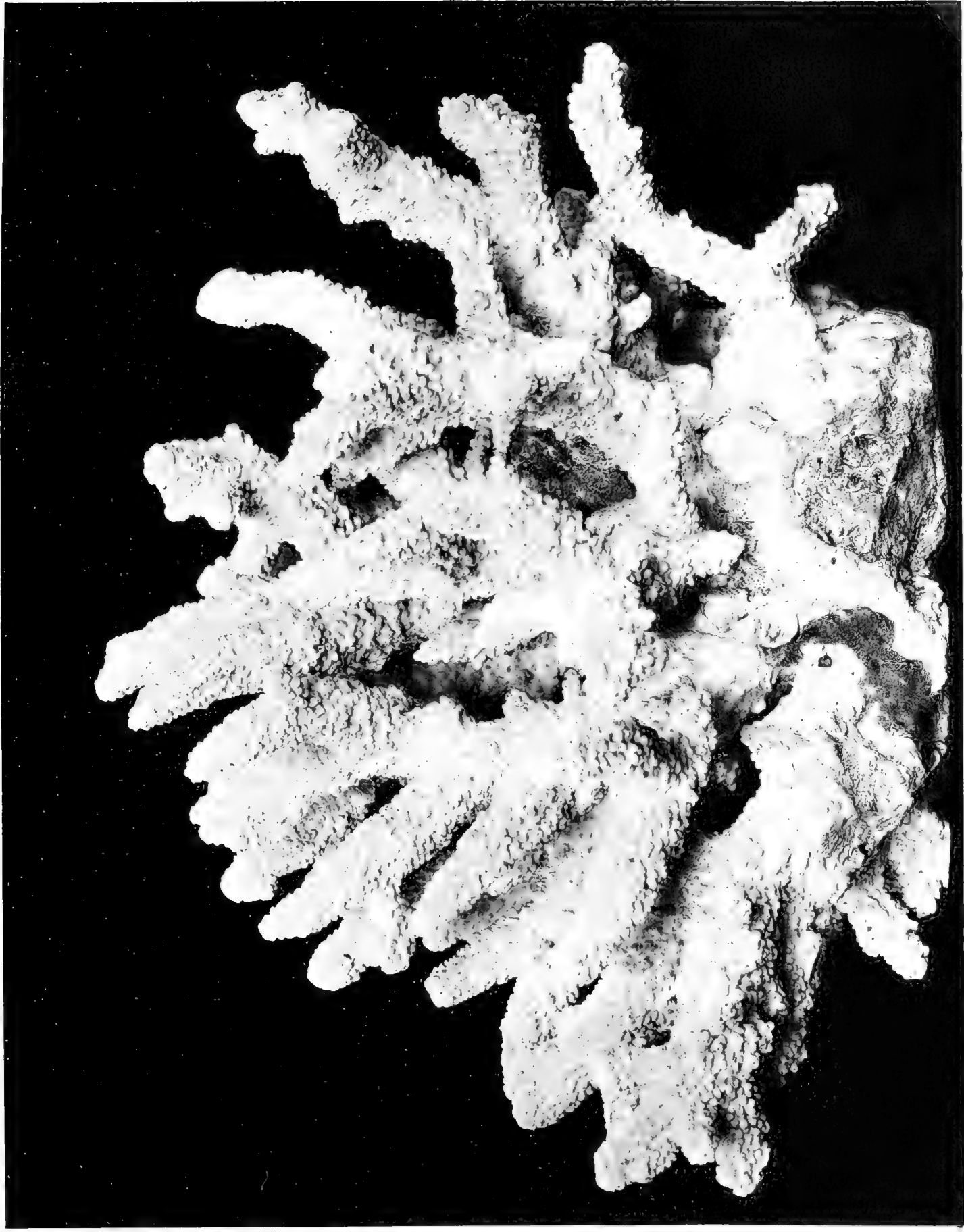


Collopy, f.c.

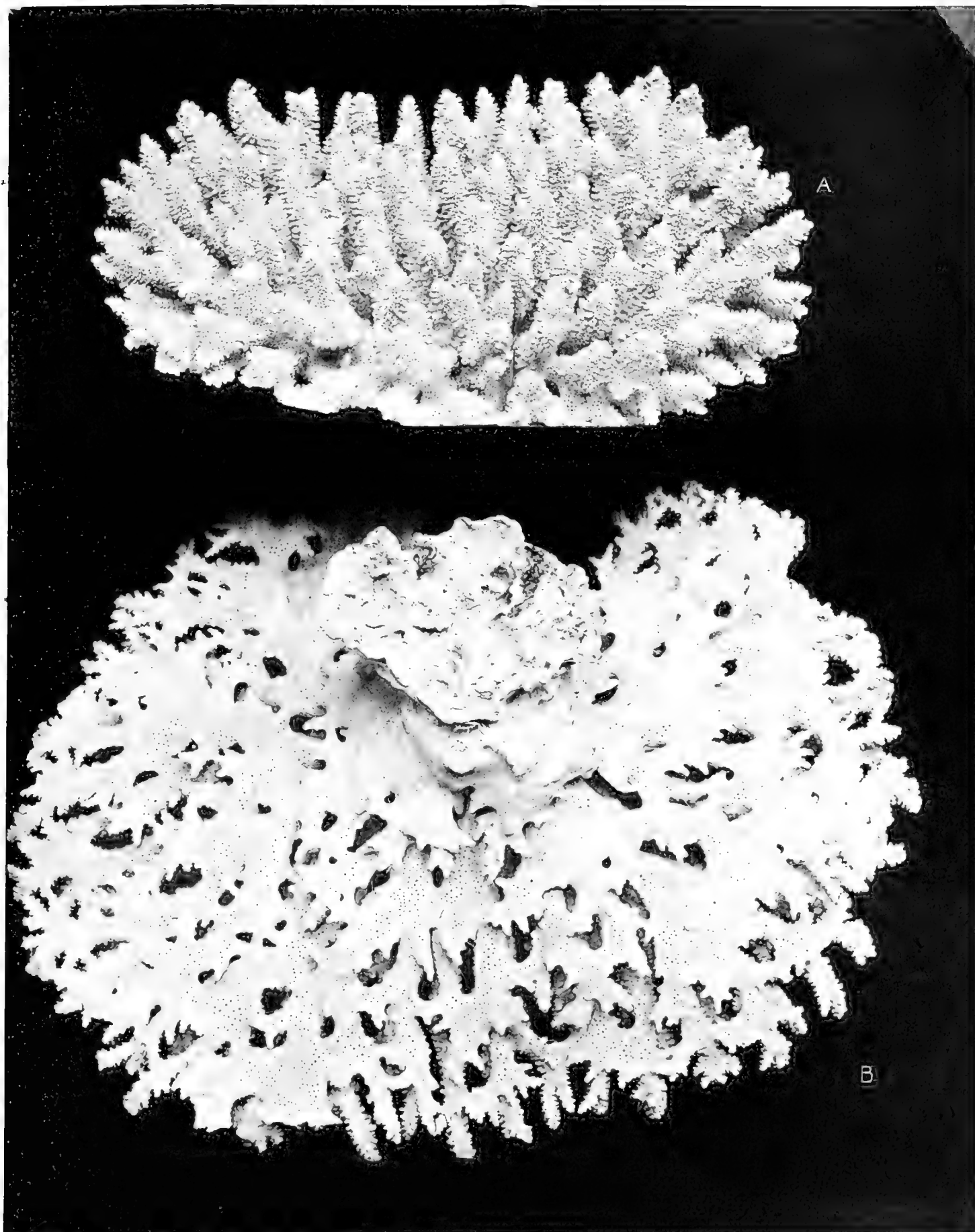
Morgan & Kidd, *Recherches*.

A. *Madrepore calamaria* var. *mammillata*. B. *Madrepore calamaria*.
C *Madrepore australis*. D. *Madrepore guppyi*. E. *Madrepore cophodactyla*.





Madrepora brueggemannii.

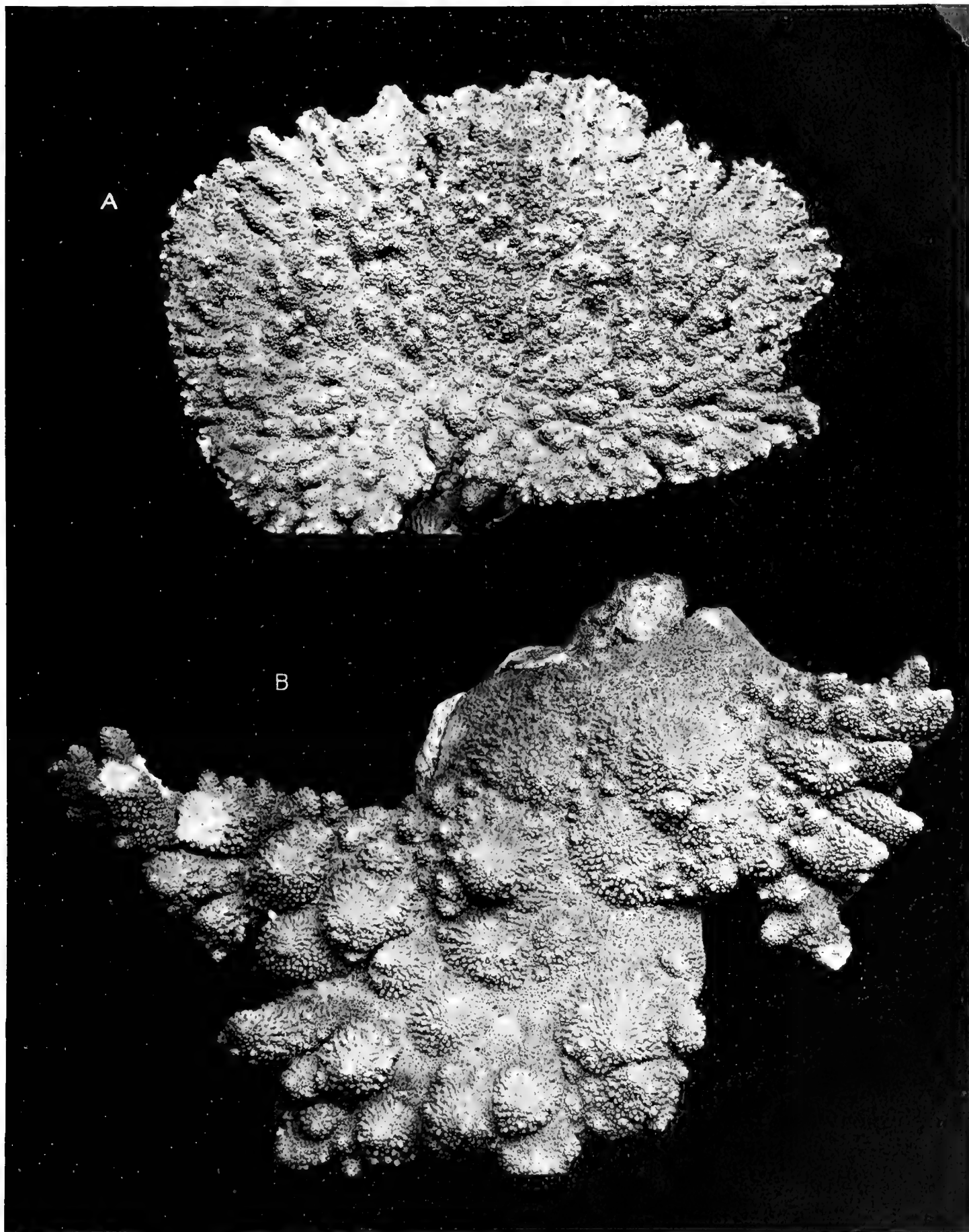


Collotype.

Morgan & Kidd, Richmond.

A. Madrepora studeri, upper surface.

B. The same, under surface.

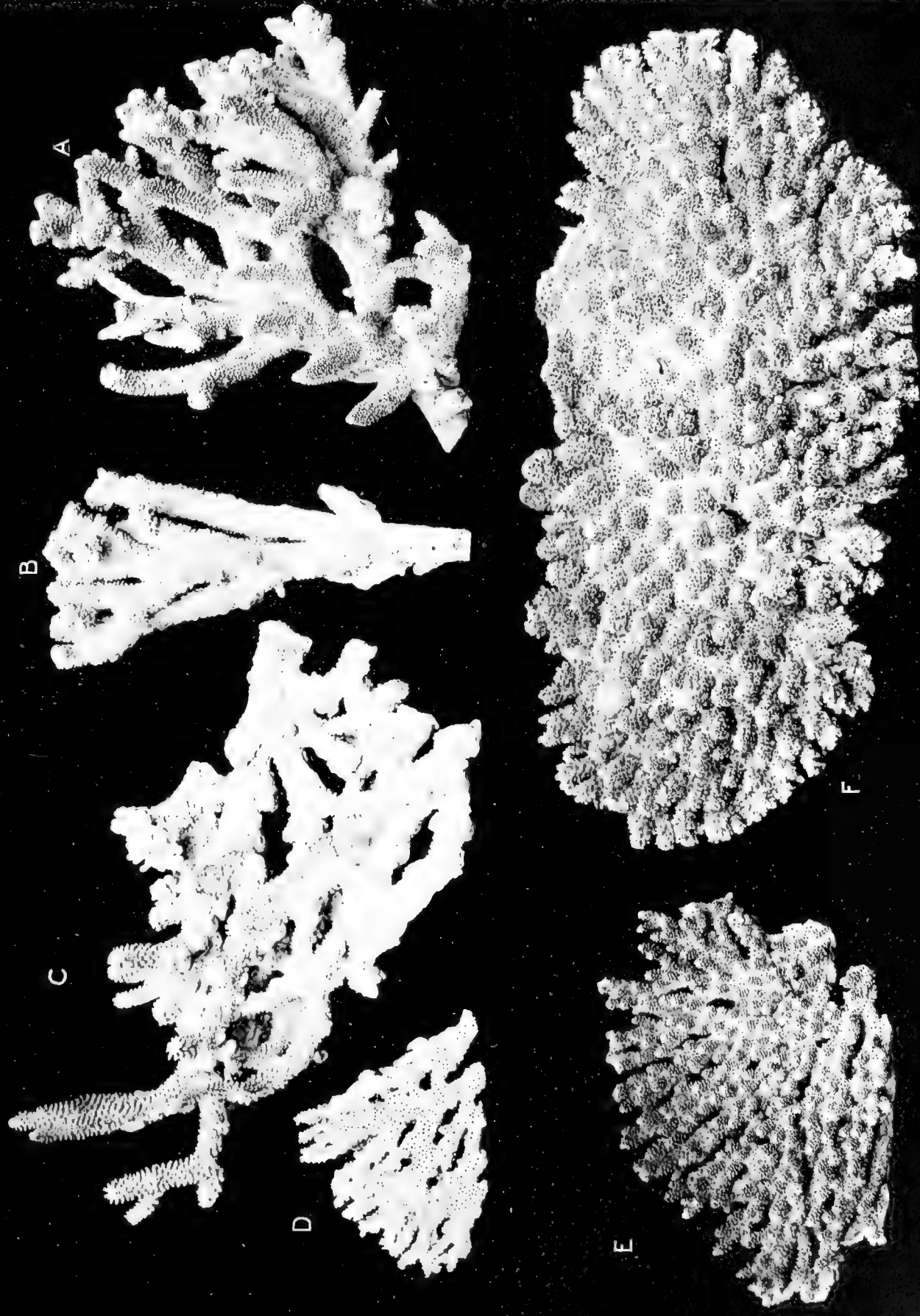


Collotype.

Morgan & K. D. Richmond.

A. Madrepora rasiformis.

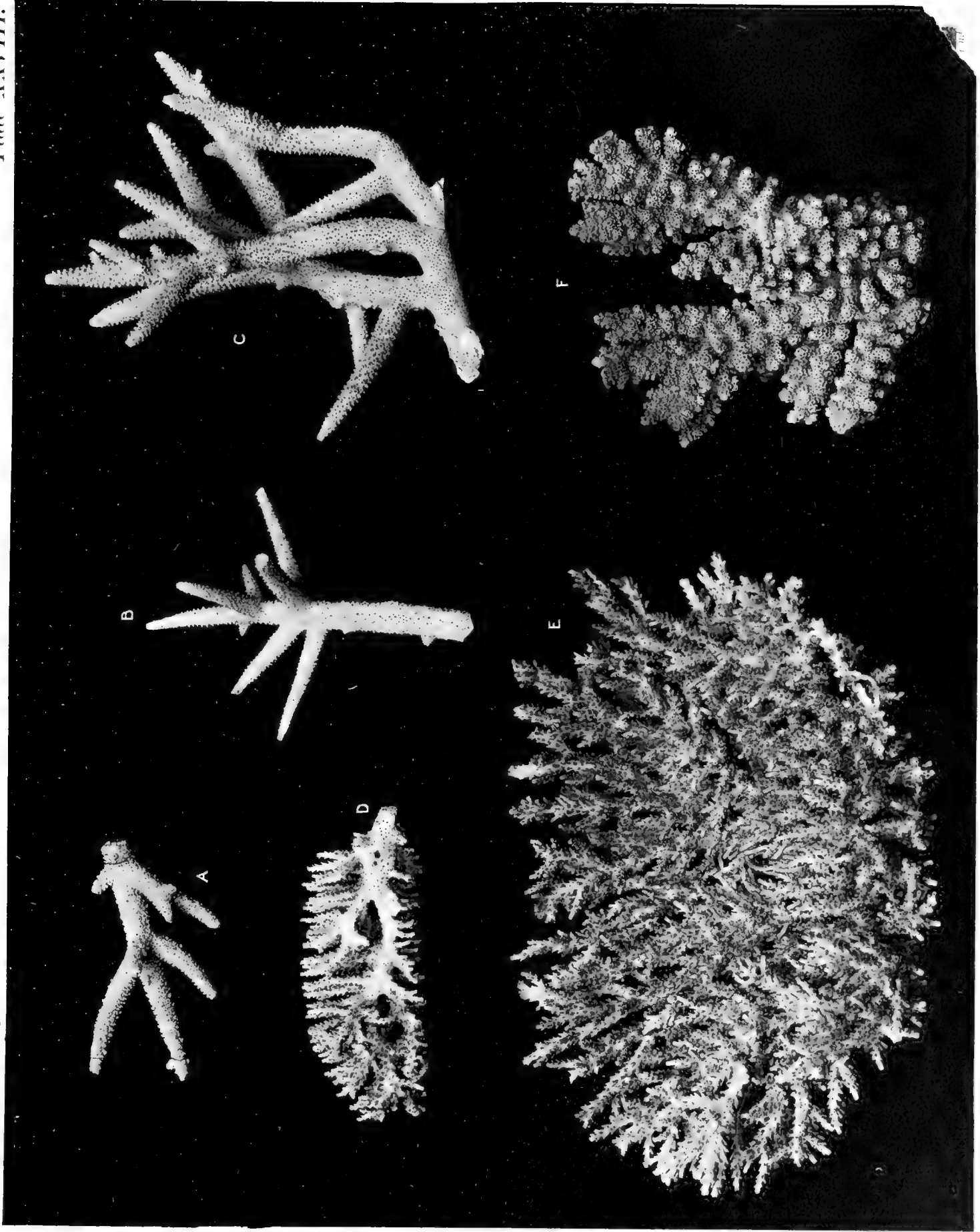
B. Madrepora smithi.



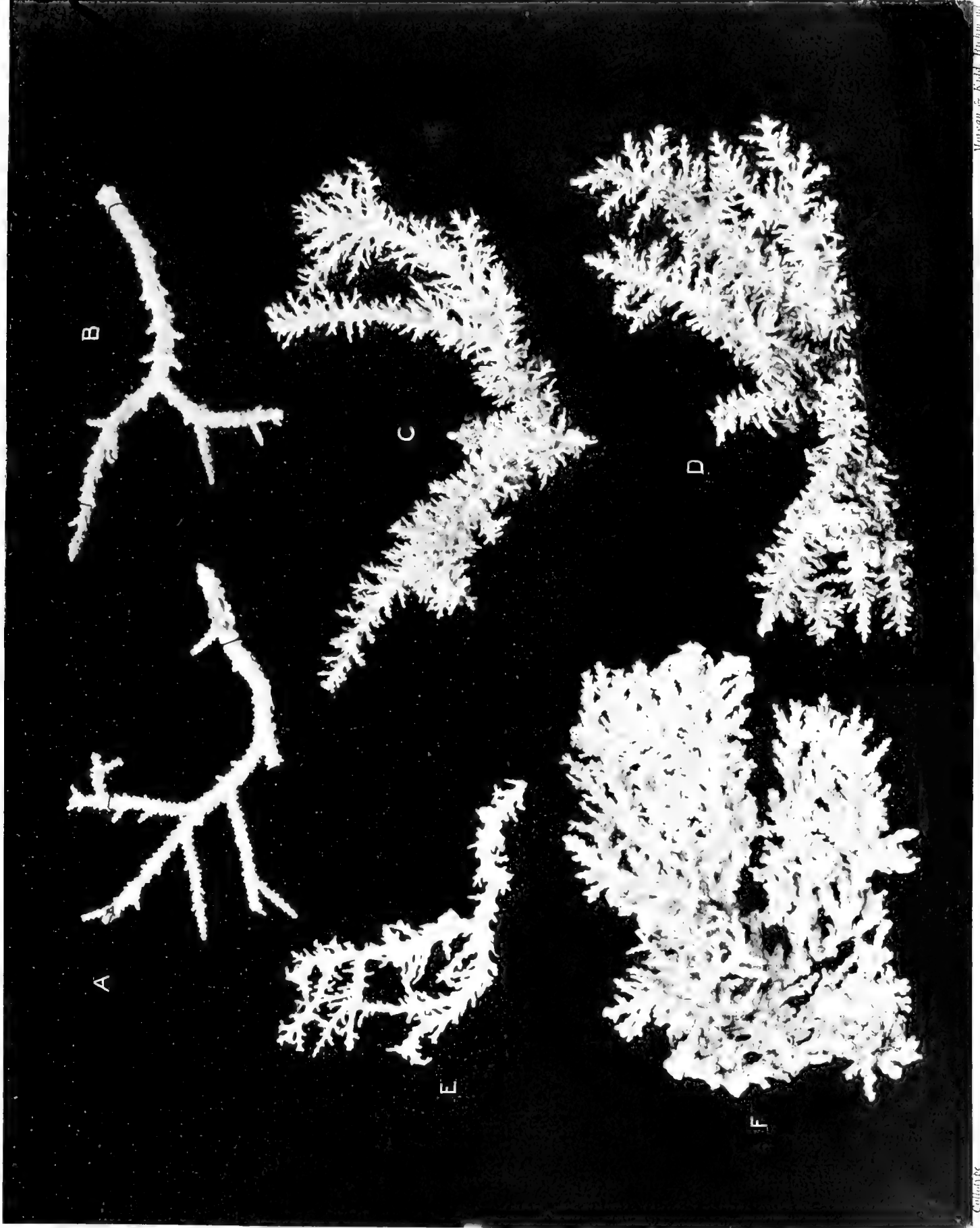
Cellulose.

Morgan & Kidd, Richmond.

A. *Madrepore brevicollis*. B. *Madrepore brevicollis*, var. *pustulifera*. C. *Madrepore nigra*. D. *Madrepore pectinata*, under surface. E. The same, upper surface. F. *Madrepore recumbens*.



A. *Madrepore pulchra*. B. *Madrepore pulchra*, var. *stricta*. C. *Madrepore pella*.
 var. *alveolata*. D, E. *Madrepore delicatula*. F. *Madrepore affinis*.

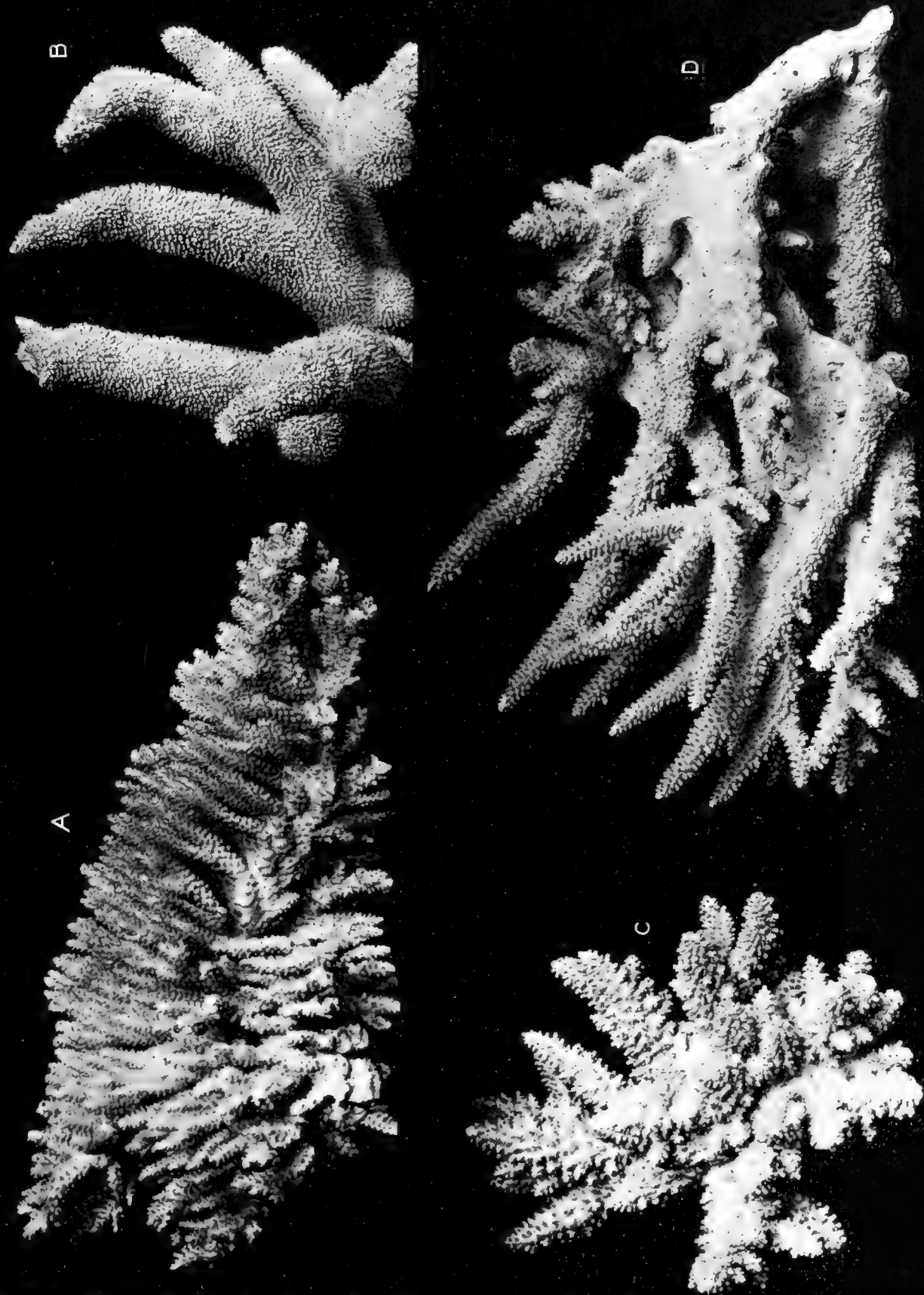


A. *Madrepora inermis*, under surface. B. The same, upper surface.
C. *Madrepora subglabra*. D. *Madrepora procumbens*. E. *Madrepora tenella*.
F. *Madrepora rambleri*.

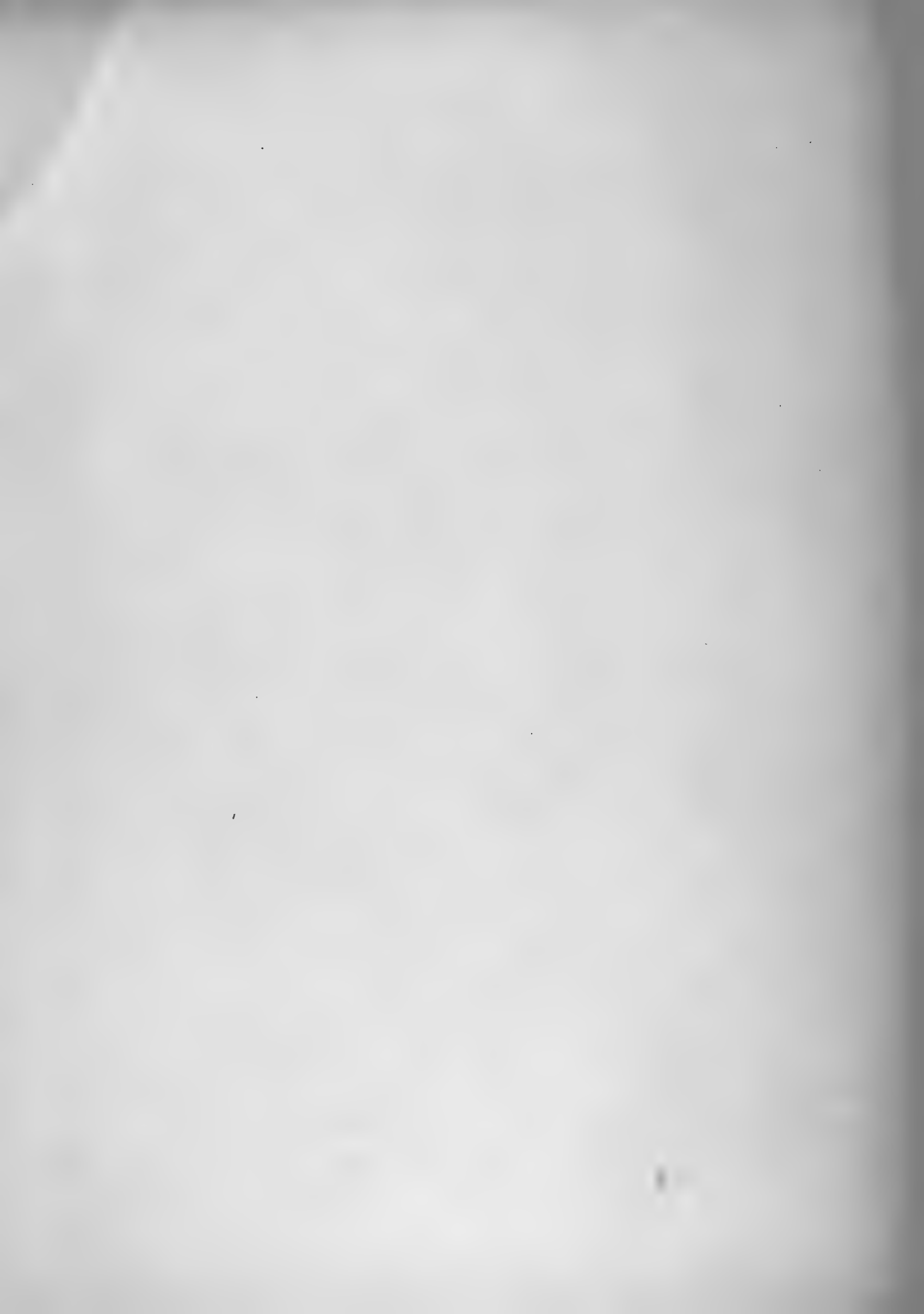
Morgan & Kidd, Richmond

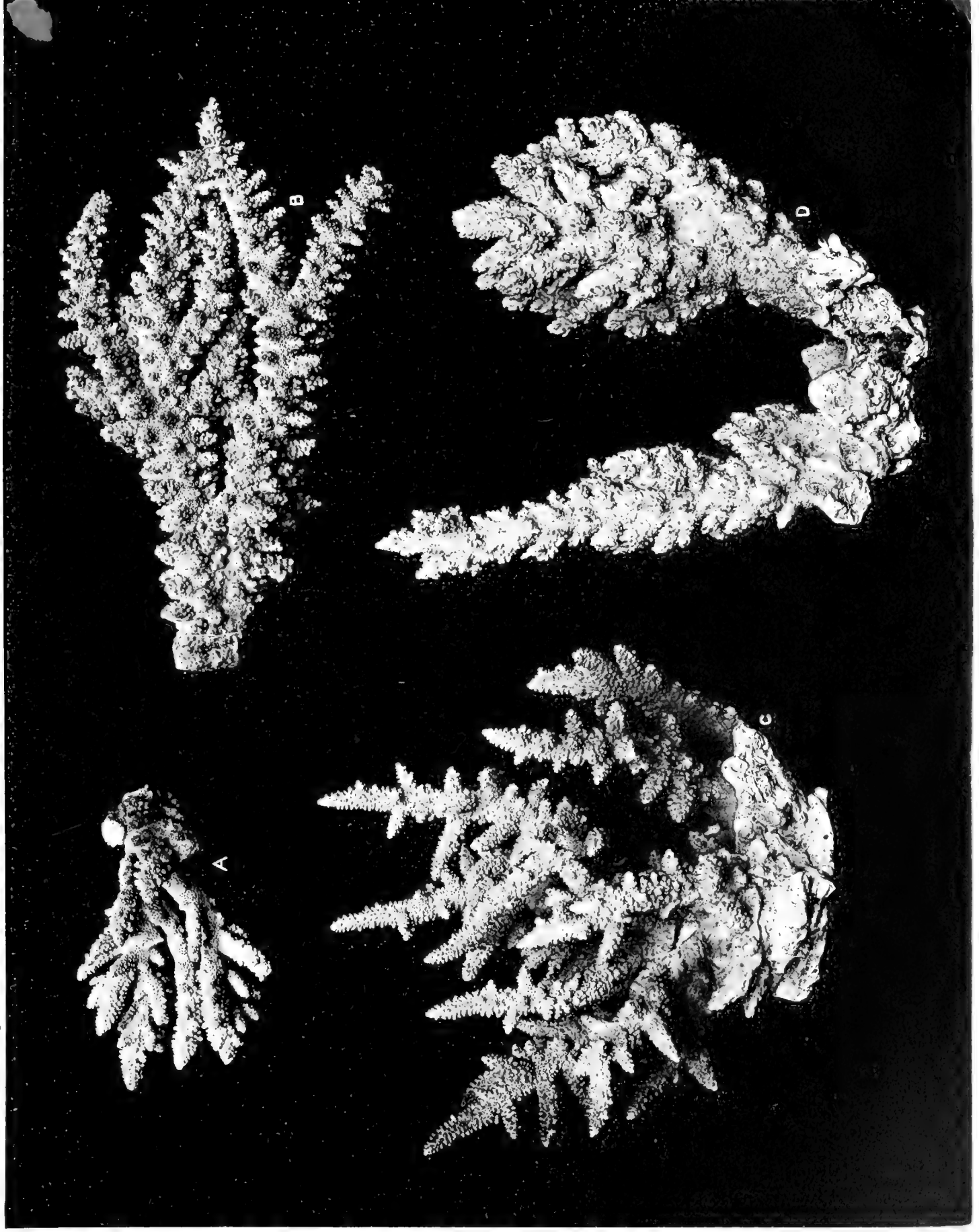
Collotype





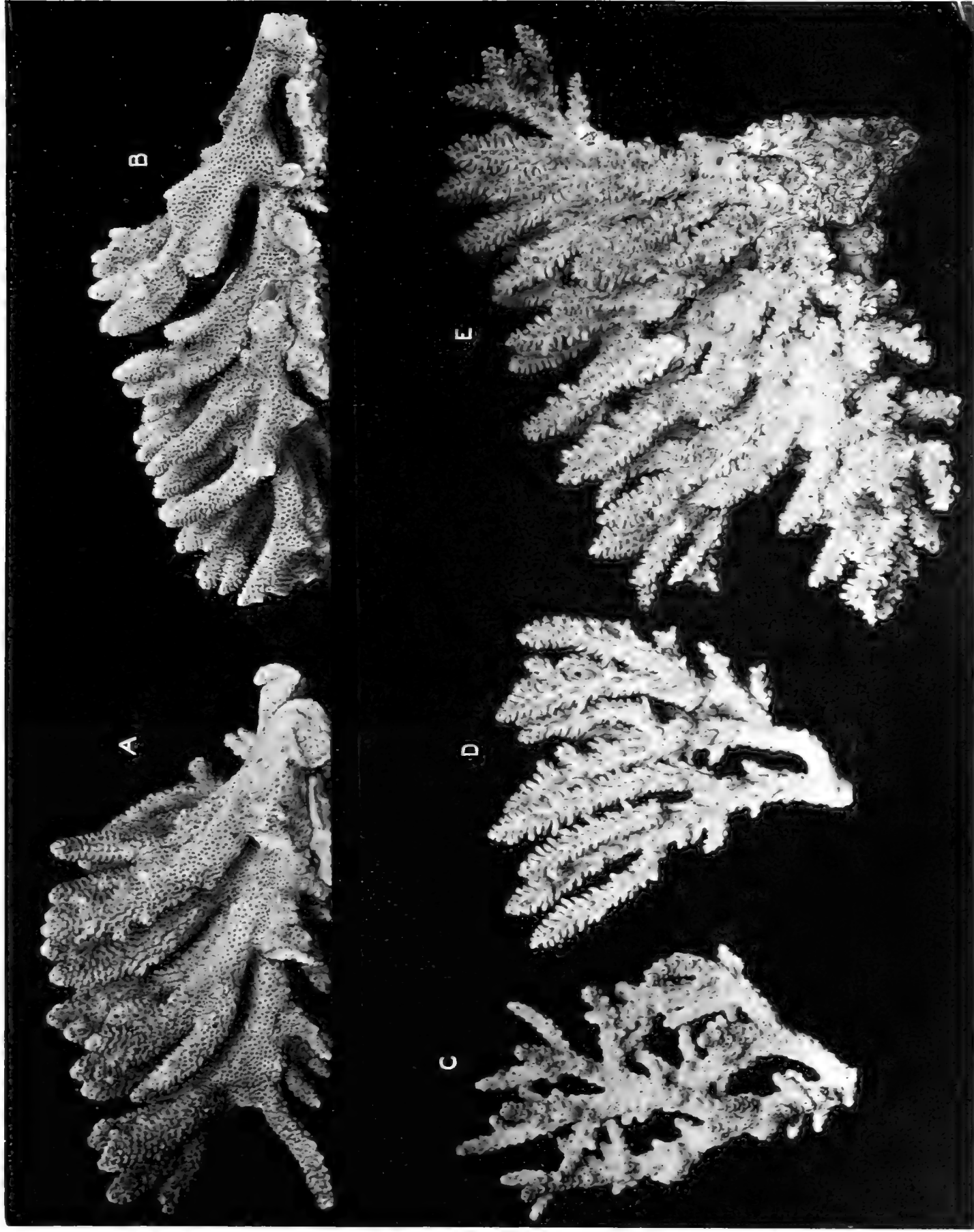
A. *Madrepore bifaria*. B. *Madrepore pacifica*. C. *Madrepore listeri*, var. *conica*.
D. *Madrepore listeri*.





A. *Madrepora samoensis*. B, C, D. *Madrepora polymorpha*.

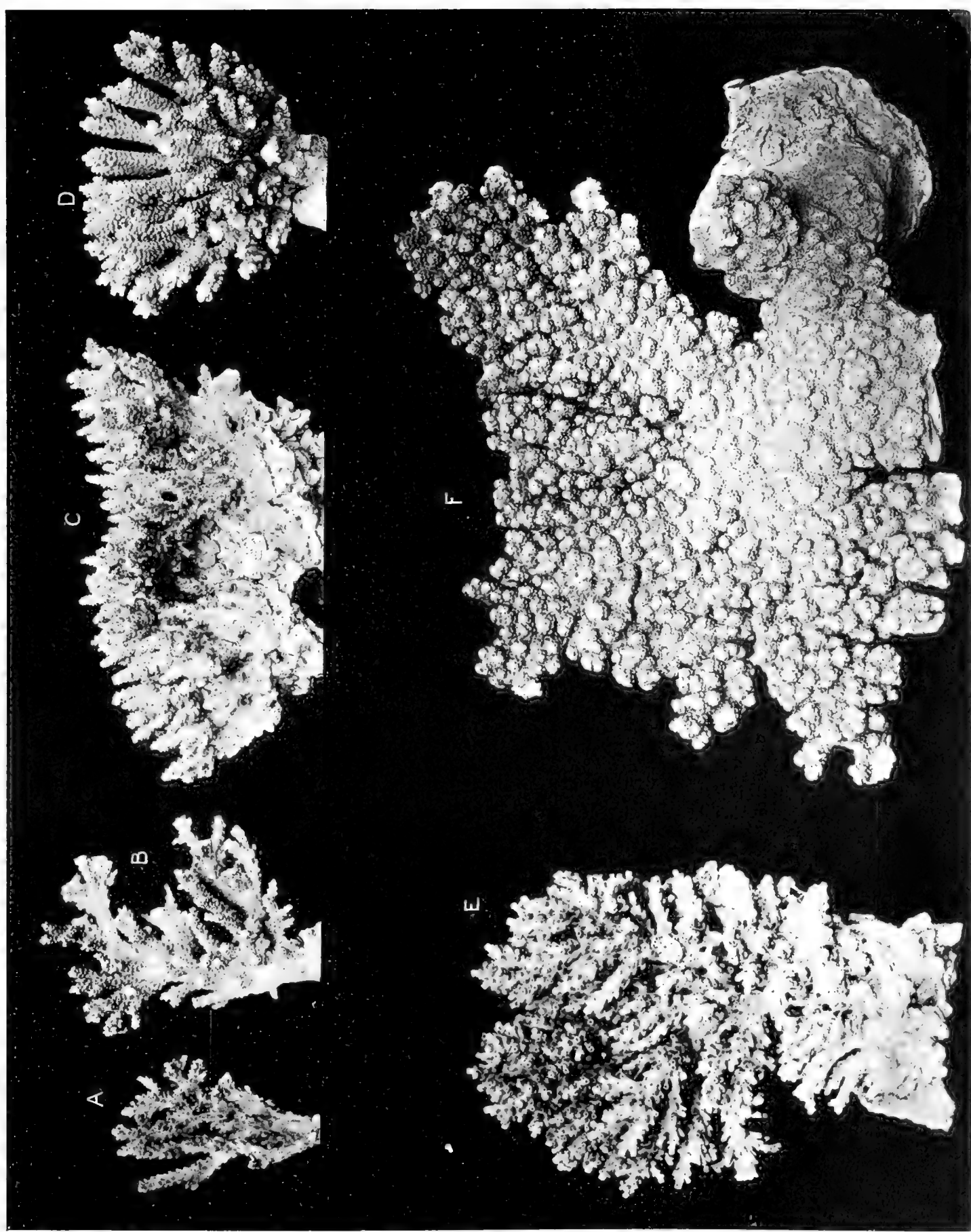




A. *Madrepore obscura*. B. *Madrepore spathulata*. C. *Madrepore cancellata*.
D. *Madrepore quelechi*, var. *paradorea*. E. *Madrepore quelechi*.

Reagon & Kidd, Richmond

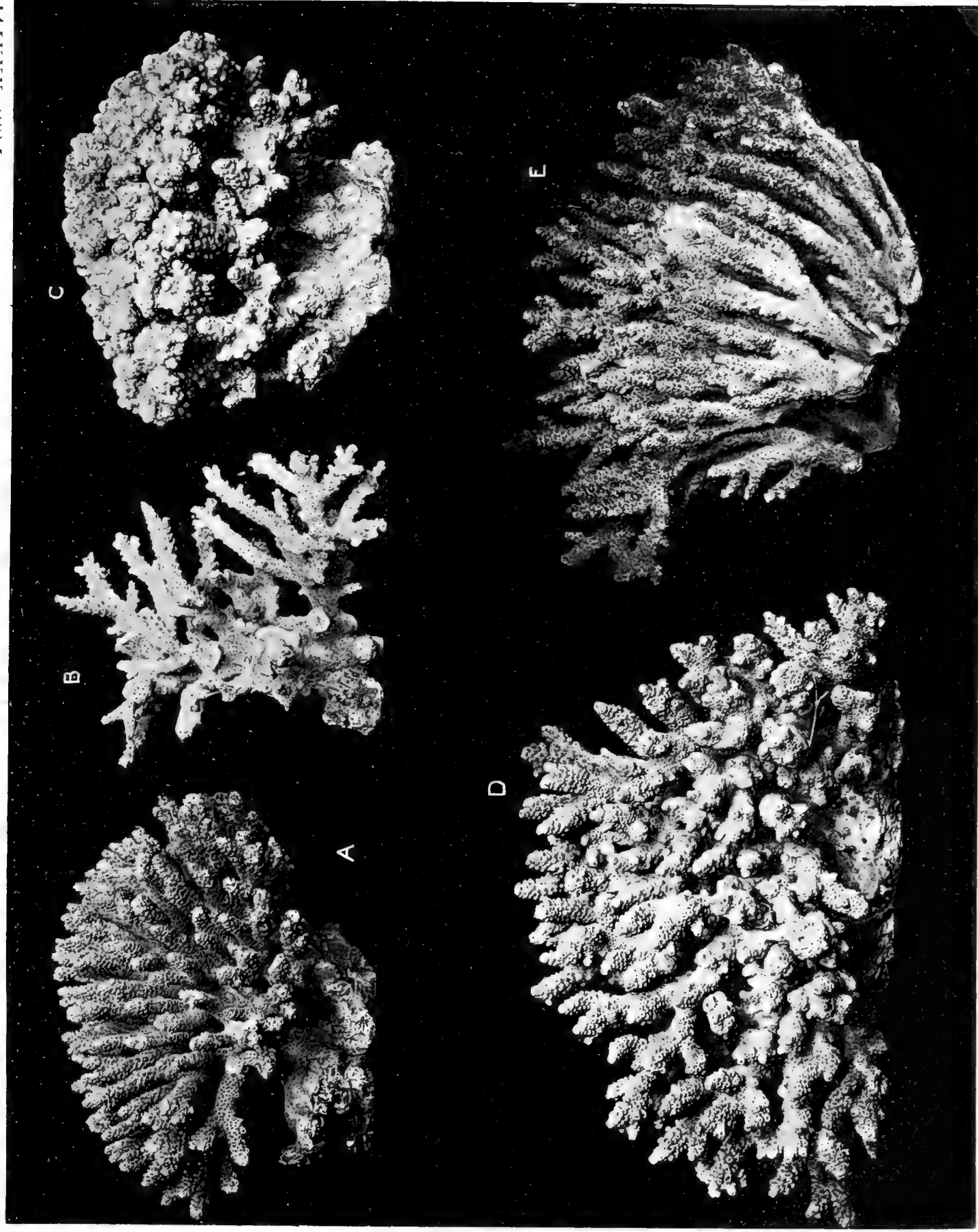
colotype.



Geddes.

Morgan & Kuld, Richmond.

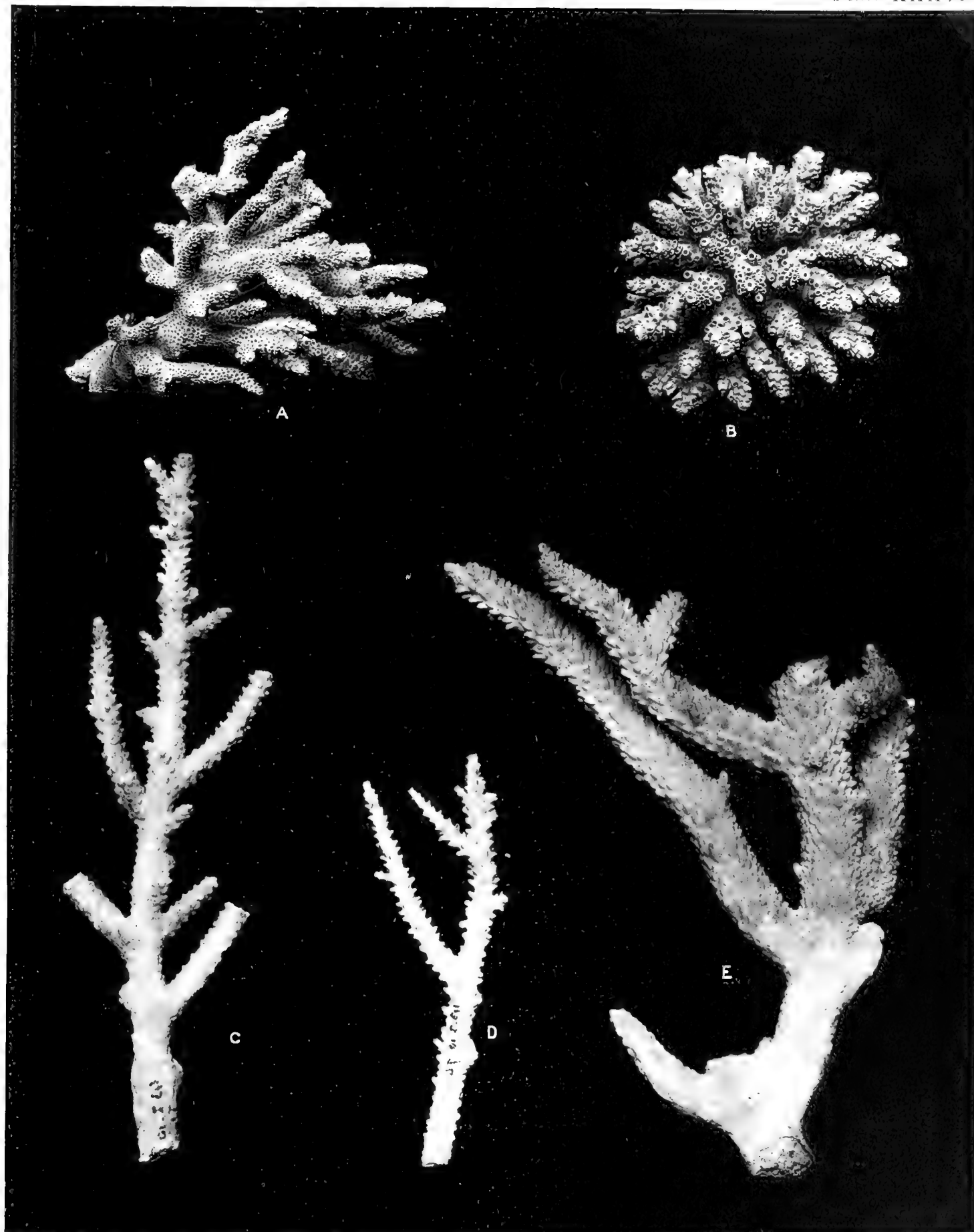
A, B. *Madrepora dendrum*. C. *Madrepora sinensis*. D. *Madrepora disticha*.
E. *Madrepora syringodes*. F. *Madrepora compressa*.



G. S. S. P.

Morgan & Kohl, Richmond.

A. *Madrepora indica*. B. *Madrepora pruinosa*. C. *Madrepora botryodes*.
D. *Madrepora glauca*. E. *Madrepora frondosa*.



Collotype.

Morgan & Kidd, Richmond.

A. *Madrepora thurstoni*. B. *Madrepora africana*. C, D. *Madrepora attenuata*. E. *Madrepora brueggemanni*, var. *uncinata*.

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